

# NORTH MANCHURIAN PLAGUE PREVENTION SERVICE

REPORTS (1911—1913)

Edited by

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Cambridge :  
at the University Press

1914

37

*Orient Periodical (Carter's Room)*



Cambridge :

PRINTED BY JOHN CLAY, M.A.

AT THE UNIVERSITY PRESS



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# I. MEMORANDUM ON THE NORTH MANCHURIAN PLAGUE PREVENTION SERVICE.

## (i) *Preamble.*

THE plan for the proper organisation of a Plague Prevention Service for North Manchuria was approved by the Central Government in 1911, and also by the Viceroy of Manchuria. Part of the work was begun in the summer, and different medical officers were appointed to take charge of different stations. The building of hospitals at Harbin, Manchouli, and Lahasusu was begun, for which various sums had already been voted. In October the revolution broke out, and the Manchurian Customs were hypothecated to the payment of the Loans and Boxer Indemnity. The Manchurian Customs Revenue thus passed into the control of the representatives of the Powers in Peking who at first refused to continue this Service. Six months then passed, and now, as a result of representations from the Wai Chiao Pu, a dispatch, dated September 19th, 1912, has been received from the Diplomatic Body, saying that the sum asked for, namely, Roubles 78,000, has been sanctioned, and work could commence at once. Instructions from the Wai Chiao Pu to the Shui Wu Chu have been sent to this effect.

## (ii) *Objects of the Service.*

1. To devise means to prevent the recurrence of Plague in North Manchuria, and to stamp it out on appearance.
2. To give effect to the recommendations of the Mukden Plague Conference, 1911, by making researches into the origin and cause of Pneumonic Plague, and its relation to marmots and other animals.
3. To introduce general sanitary measures in the regions mentioned, and, wherever possible, to treat and study local diseases.

(iii) *Geographical Limits within which the Service will Function.*

The operation of the Service will at present be confined to North Manchuria. It is proposed to establish, as far as possible, sanitary stations, each with a competent medical officer in charge, at Harbin, Manchouli, Lahasusu, Sansing, and Taheiho, the first being the headquarters of the Service. Should it be necessary to pursue investigations in regions beyond these towns, full discretionary powers will be given to the Director and Chief Medical Officer for the purpose.

(iv) *Powers, Duties, and Responsibilities of the Director and Chief Medical Officer.*

1. The Director and Chief Medical Officer is appointed by the Wai Chiao Pu and derives his authority from and is responsible to that Board alone.

2. His appointment will be notified to the Tutuhs of Manchuria for their information and approval, and he will be authorised to consult with them direct, and receive every available assistance from them on all matters connected with the Service.

3. He will have general management of the Service; the appointment, distribution, and dismissal of the technical staff will be in his hands, and he will be responsible to the Central Government for discipline and efficiency.

4. He will be responsible for the manner in which the funds allotted for the maintenance of the Service are expended, and his authority will be required for all payments either of a standing or special nature.

5. He has the power at his discretion to authorise appropriations to be made for any special purpose so long as that purpose is connected with plague and medical work and investigations, and provided that the yearly limit of Rs. 78,000 is not exceeded.

6. His salary at the rate of Rs. 650 per mensem will be paid from the funds allotted for the Service.

7. He will, except when travelling in the district, reside at Harbin, which will be the headquarters of the Service.

8. He will take over at the first opportunity all existing hospitals, equipments, and balance of funds in connection with the hospitals in the



district. Such funds will be passed over to the Treasurer for the purposes originally intended.

9. He will make Quarterly Reports to the Wai Chiao Pu as to the progress of the work under his jurisdiction. Special reports may be submitted when necessary. He will also make supplementary reports to the three Tutuhs of Manchuria.

10. The above rules will take effect for one year from October 1st, 1912.

(v) *Powers, Duties, and Responsibilities of the Lay Director and Treasurer.*

1. This post will be occupied by the Harbin Commissioner of Customs under the authority of the Inspector-General of Customs.

2. The appointment of the Harbin Commissioner as Lay Director and Treasurer of the North Manchurian Plague Prevention Service will be notified to the Tutuhs of Manchuria, but, except in the absence of the Director and Chief Medical Officer from the district, he will not correspond with them on matters connected with the Service.

3. He will be responsible for the safe-keeping of the funds allotted for the maintenance of the Service; he will issue them from the Revenue moneys in his control and deposit them in a special North Manchurian Plague Prevention Service bank account, on which he alone will have authority to draw.

4. He will issue all salaries and supply the necessary funds for all expenditure duly sanctioned by the Director and Chief Medical Officer.

5. He will keep the accounts of the Service and render them quarterly to the Inspector-General for transmission to the Wai Chiao Pu.

6. He will assist the Director and Chief Medical Officer with his advice on the details of administration, and direct his subordinates, wherever the Service extends, to do likewise to the Medical Officers. The Lay Director and Treasurer will not interfere with the technical direction of the Service.

7. He will maintain at the Customs House an office with the necessary staff under his own orders to attend to his special duties in connection with the administration of the Service. The expenses of this office together with a monthly allowance to the Lay Director and Treasurer of Rs. 160 per mensem will be paid from the funds allotted for the Service.

*Memorandum*

He will also provide at the Customs House, in order to facilitate business, an office for the Director and Chief Medical Officer.

8. In the absence from the district of the Director and Chief Medical Officer, the control of the Service will be vested in the Lay Director and Treasurer who will be advised in all technical matters by the Senior Medical Officer at Harbin.

9. The above rules will take effect for one year beginning from October 1st, 1912.

(Sgd.) WU LIEN-TEH.

PEKING, *September* 25, 1912

## II. SUMMARY OF ANNUAL GENERAL REPORT.

HARBIN, 30th September, 1913.

To

*His Excellency*

*The Minister for Foreign Affairs,  
Peking.*

SIR,

I have the honour to submit a brief summary of the Annual General Report of the North Manchurian Plague Prevention Service for the year ending September 30th, 1913.

The full Report is now in the hands of the printers (Cambridge University Press, England) and will, I hope, be ready for distribution in November of this year.

2. It may be remembered that the establishment of the above Service was sanctioned by the Wai Chiao Pu and that the Diplomatic Body in Peking agreed to the withdrawal of a sum of Roubles 78,000 from the Customs revenue for its maintenance during the year.

3. I beg to draw your attention to the following:—

(a) The Central Office has been established in the Customs Buildings, Harbin, where the Director and Chief Medical Officer and the Lay Director and Treasurer transact the administrative portion of the work.

(b) The Harbin Isolation Hospital, consisting of a North Block containing a Suspects' Hospital and a Plague Hospital, and also a South Block comprising a Quarantine Hospital and a Disinfection Station, was opened for the treatment of patients on December 16th, 1912. The formal opening took place on August 27th of this year in the presence of the representative from the Wai Chiao Pu, the representatives of the Governors of the Three Provinces, the Consuls at Harbin, General Horvat and other high officials of the Chinese Eastern Railway, the principal Russian residents of Harbin, the Medical Officers of the Chinese Eastern and South Manchurian Railways and the Russian Red Cross Hospital, and the leading Chinese officials, gentry, and merchants.



The Harbin Hospital buildings cover an area of four acres with a frontage of 500 feet, and has accommodation for at least 20 suspect cases, 30 plague cases, and 250 contact cases. Since its opening 10,169 patients suffering from diseases of a general character have been treated. This hospital contains, among other things, a disinfection station equipped with the latest appliances, including a large Thresh Disinfector, a Bacteriological Laboratory for Research work, a Museum, a Reference Library containing in addition to the latest medical and scientific books, all the available literature on Plague, an Operating Theatre fitted for general surgical work, besides the usual wards and out-patient clinics.

The Hospital buildings and their equipment, together with drugs, have cost about Roubles 64,000.

(c) The Lahasusu Hospital was completed in November 1912, and has been used as a general hospital since October 16th, 1912. This hospital is situated in a prominent position at the bend of the River Sungari just before its junction with the River Amur. It consists of a two-storeyed building for the Medical Officer above, and an Out-patient Department below, as well as separate Quarantine, Plague, and Suspect Blocks. The hospital has accommodation for 42 in-patients.

(d) The necessary site and buildings for a hospital at Sansing have been purchased and patients have been treated since the beginning of June.

(e) The Taheiho Hospital, costing Roubles 15,378, which was begun as soon as the river was open for navigation, is nearing completion. A medical officer has been stationed there since June 8th.

(f) The following comprise the principal *personnel* of the Service since its inauguration :

Dr Wu Lien-Teh, M.A., M.D., B.C. (Cantab.), Director and Chief Medical Officer.

Mr W. Haines Watson (Commissioner of Customs), Lay Director and Treasurer from October 1st, 1912 to April 15th, 1913.

Mr R. de Luca (Commissioner of Customs), Lay Director and Treasurer from April 16th, 1913.

Dr Ch'en Szu Pang, M.B., B.C. (Cantab.), Senior Medical Officer, Harbin.

Dr F. E. Reynolds, M.B., Ch.B. (Edin.), Senior Medical Officer, Taheiho: acting as Bacteriologist to the Service.

Dr Luk Chun Hsuan (graduate of Peiyang Medical College), Assistant Medical Officer, Lahasusu, October 1st, 1912 to June 4th, 1913. Taheiho from June 8th, 1913.



Dr Tang Tsung Nin (graduate of Peiyang Medical College), Assistant Medical Officer, Harbin, November 16th, 1912 to May 24th, 1913. Sansing from May 27th, 1913.

Dr Liu Yi Te (graduate of Union Medical College, Peking), Assistant Medical Officer, Harbin, from May 5th, 1913.

Dr Hwang E (graduate of Peiyang Medical College, and late Army Surgeon, Paotingfu), Assistant Medical Officer, Lahasusu, May 16th to August 15th, 1913—resigned.

Dr Ts'uei Ch'ang Shan (graduate of Union Medical College, Peking), Assistant Medical Officer, Lahasusu, from September 22nd, 1913.

Matron Tsao Feng Hui Ch'ing, Harbin Hospital, from June 8th, 1913.

Nurse Yeh Ch'en Ping Tuan (graduate of Nurses' Training College, Foochow), Harbin Hospital, from May 25th, 1913.

One of the most important objects of the Service is to utilise every means at its disposal with a view to giving an efficient training in preventive medicine to medical men who will, in future, carry their acquired knowledge to other portions of the country. This, in itself, is a cause worthy of energetic support, seeing that such work has been commenced in China only under the auspices of the North Manchurian Plague Prevention Service.

(g) The work performed by the medical staff under my direction has been satisfactory. From the beginning all have understood that their duties are educational as well as clinical, and that they should spread the modern doctrines of Public Health and Prevention of Disease among the masses. For this purpose public lectures illustrated with lantern slides and the issue of pamphlets in simple language have been carried out. Attempts have also been made to win the confidence of the people so that accurate statistics on births, deaths, etc., may be obtained. A marked change for the better in the attitude towards these public health matters has already been noticed, and it is hoped that it will be possible ultimately for our medical officers to obtain a voice in the direction of sanitary affairs, the control of which is at present in the hands of bodies composed entirely of laymen.

(h) Thanks to the hearty cooperation of the Lay Director and Treasurer, it has been possible to carry out this extensive work on an economical basis, and I wish to acknowledge the unfailing courtesy of both Mr W. Haines Watson and Mr R. de Luca.

(i) I took the opportunity when sent by the Government to attend the International Medical Congress in London (Aug. 5th—12th) to read a paper on "Investigations into the relationship of the Tarbagan to Plague," based on the work carried out by the Service on this important question. The greater part of my paper has appeared in the *Lancet* of August 23rd, and the *Journal of Hygiene* will publish in its October issue the full Report of the scientific researches carried out by the members of the Service.

In collaboration with G. Sims Woodhead, Professor of Pathology at Cambridge, I am publishing an article on "The Morbid Anatomy of Pneumonic Plague" in an early issue of *The Journal of Pathology and Bacteriology*.

(j) During the past year many rumours have appeared in the papers and elsewhere of outbreaks of plague (*e.g.* at Changchunling), of small-pox (*e.g.* at Ashiho), and of cholera (*e.g.* at Hulan). In each instance the places were immediately visited by our medical officers, and the rumours were proved to be unfounded.

(k) During the past year no case of plague has occurred throughout Manchuria, and the general health of the province has been good.

(l) I was obliged to do much railway travelling in the course of my work, and I desire to take this opportunity of expressing my gratitude to the Chinese Government Railways, the South Manchurian Railway, and the Chinese Eastern Railway, for their courtesy in allowing me free passes to travel on their lines.

4. It will be seen from the above that the Service has done as much as can reasonably be expected within the period. It is evident from the way in which the officials and public have welcomed our work that the Service has supplied a long-felt want. It is to be hoped that not only will the encouraging progress thus made in preventive medicine in China be allowed to continue, but that an impetus will be given to extend our sphere of activity. The yearly allowance of Roubles 78,000 terminated in September; so I trust that an extra grant extending for a longer period will be sanctioned by the Board.

I have the honour to be,

Sir,

Your obedient Servant,

(Sgd.) WU LIEN-TEH,

*Director and Chief Medical Officer.*



III. "INVESTIGATIONS INTO THE RELATIONSHIP OF THE TARBAGAN (MONGOLIAN MARMOT) TO PLAGUE," AND OTHER ARTICLES.

BY WU LIEN-TEH (G. L. TUCK), M.A., M.D., B.C. (CANTAB.),  
*Director and Chief Medical Officer, and late President of the International Plague Conference, 1911.*

[Reprinted from *The Journal of Hygiene.*]

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## I. INTRODUCTION.

IMMEDIATELY following on the International Plague Conference held in Mukden in April, 1911, the Chinese Government, anxious to carry out the recommendations of the Conference, instituted the North Manchurian Plague Prevention Service. The chief of these recommendations were briefly :

(a) Systematic investigations should be made as to whether epizootic plague occurs among Tarbagans and other rodents, and, if such exists, an accurate investigation should be made of the nature of the infection.

(b) A general improvement in the sanitary condition of cities and villages, especially with regard to overcrowding, is desirable.

(c) Education of the public by lectures and the issue of pamphlets and handbills, explaining preventive measures in simple language.

(d) The need for isolation of pneumonic-plague patients being urgent, permanent hospitals should be available.

(e) Hospital accommodation for suspected cases of plague should be provided.

(f) Contact quarantine stations should be constructed<sup>1</sup>.

The primary object of the scheme was the formation for North Manchuria of a medical service equipped and ready to act and control any situation that might arise through an outbreak of plague in the district, and also to maintain hospitals at Harbin (the headquarters of the Service), Aigun (Taheiho), Sansing, Lahasusu, Manchouli, and any other town in the district where such an institution might be necessary. In addition medical service was to be given to the poor and destitute, and when the hospital accommodation was not required for plague cases, general medical, surgical and infectious diseases were to be treated in the wards. Further, medical officers in the Service were to instruct the people in general hygiene, etc.

It was hoped that the Service would develop into a Public Health Service for the whole of China. The funds for building the hospitals were to be derived from the current revenue of the three Manchurian Provinces, while the Service was to be maintained out of the Maritime Customs dues.

<sup>1</sup> Incidentally, it may be mentioned that the Chinese Government had already established isolation hospitals and segregation camps, each capable of holding from 400 to 2000 persons, at the important railway centres of Shanhaikuan, Mukden and Koupangtzu and at the sea-port of Yingkow (Newchwang). The director of the N. Manchurian Plague Prevention Service is consulting physician to these establishments.



The Revolution which broke out in October 1911, however, delayed matters; later on the Manchurian Customs, which hitherto had remained a separate entity controlled by the Chinese Government directly, were temporarily given over to swell the general Customs Revenue of China in order to pay the Loans and Boxer Indemnities.

It was not until September 1912 that arrangements were finally made to allot the sum of 60,000 taels (78,000 roubles) a year of the Chinese Customs Revenue of Harbin for the maintenance of the Service.

The Manchurian Plague Prevention Service was thus established on a firm basis on October 1st, 1912, although  $1\frac{1}{2}$  years previous to that date, medical officers had been stationed at Manchouli, Harbin, Tsitsihar (capital of Heilungkiang Province), and Lahasusu to carry out the objects for which the Service was founded.

In the preparation of this Report, I have received considerable assistance from my staff, particularly Dr S. P. Ch'en, M.B., B.C. (Cantab.), Senior Medical Officer at Harbin, and Dr F. E. Reynolds, M.B., Ch.B. (Edin.), Bacteriologist of the Service.

Among the delegates of the International Plague Conference, Mukden, April 1911, it was generally believed that there was a close connection between Plague—or at least the recent epidemic of Pneumonic Plague of Manchuria—and the Tarbagan or Marmot (*Arctomys bobac*, Schreb.).

So little is known about this animal and the grounds for associating it with Plague were based on such slender scientific evidence—as will appear later in this Report—that it seemed to me the first step in the investigation of this question was to organise an expedition into the country where the Tarbagan abounds, and there to study its habits and the conditions under which it lives and to carry out scientific investigations as to the presence of Plague among the animals.

For the sake of clearness, it is well to state here that the Tarbagan hunting is divided into two seasons:

I. Spring season, lasting from the end of April to the beginning of June.

II. Autumn season, lasting from the middle of August to the end of September.

The subject, however, will be dealt with in greater detail later in this Report.

On the morning of May 26th, 1911, I arrived at Manchouli to make enquiries as to the conditions under which hunting took place, and to gather information which would prove useful in making arrangements

for an expedition into the Tarbagan country later in the year. My observations made at that time are embodied in this Report. I left Manchouli on the evening of May 29th and returned to Harbin. About this time of the year large numbers of coolies arrive in Harbin principally from the province of Shantung to find work in the north. Most of them obtain employment along the Sungari and Amur rivers. On May 30th I saw a train reach Harbin station with over 1000 coolies; like others from Shantung, they possessed a fine physique and were in the best of health. Soon afterwards official business took me to Peking.

In the beginning of July rumours were afloat that a large number of Tarbagans were dying in the neighbourhood of Scharasone (Transbaikalia, Siberia). On July 11th I left Tientsin with orders to organise an expedition to investigate the matter, as the Chinese Government were most anxious that all measures should be taken to forestall a possible spread of Plague to man. The Manchurian authorities agreed to build hospitals for Plague at all the important centres and instructed me to staff them with properly qualified medical officers; and from the Viceroy at Mukden downwards, all the officials took great interest in the proposed expedition. I quote the following from the *Peking Daily News*:

*Tarbagan Epidemic in Siberia spreading southwards.*  
(Special Dispatch to the *P.D.N.*)

HARBIN, *July 13th.*

“My correspondent at Station Manchouli wires that the Tarbagan epidemic of Siberia is spreading southwards towards the Chinese frontier. Dead marmots are now found as far south as Scharasone which is only thirty-five miles north of the Russian-Chinese frontier. Local measures are sufficiently strict to prevent the disease from entering Manchuria. Some members of the Chinese Scientific Expedition for the study of Tarbagan diseases have already arrived here.”

Arriving at Harbin on July 15th, I called on Professor Zabolotny, who was at that time working at certain plague problems in the Russian Laboratory of that town. After showing me his specimens and telling me the results of his investigations—a note of which appears in this Report—he invited me and my party to proceed with him to Manchouli in a special car provided by the Chinese Eastern (Russian) Railway. I gladly availed myself of the invitation. It is interesting to note that this was the first scientific expedition sent out by the Chinese Government.



The Russian party consisted of Professor Zabolotny, Drs Tschourilina (a lady) and Issaief (see Pl. II, fig. 3). Our own party consisted of Dr Ch'en Sze-pang, M.B. (Cantab.), Dr Tsang Pu and myself. Our investigations form the basis of this Report.

## II. ITINERARY.

Leaving Harbin we arrived at Manchouli Station on July 21st and arranged that this should be the base of the Chinese Expedition. We gave instructions that huts should be built for us, for the laboratory, and for the animals. The next day Dr Ch'en and myself left for Borsja<sup>1</sup> (Transbaikal District) to join the Russian party who had their base there. We remained with them for a week, visiting Tschintansk, Arabulak and the neighbouring villages. On July 29th we returned to Manchouli to rejoin our party. A few days afterwards the Russian staff broke up, Prof. Zabolotny and Dr Tschourilina returning to St Petersburg and Dr Issaief to his station on the Russo-Chinese frontier. Our start for Mongolia to make further investigations was delayed by the rainy weather until August 6th. Proceeding westward we reached Charbada on the 7th, where we encamped for two days. On August 9th we left for Kerloni. As there was no direct way there we had to return to Manchouli and from thence proceeded in a south-westerly direction parallel to the large but shallow river called Kerulen, which after it has passed through Kulun Nor (Kulun See) is called River Argun, and later on becomes the Amur. We travelled southwards, passed Zagan on the east, and after two days reached the large lake, Kulun See. Finally we encamped at Kerloni—a Mongol colony situated on the river—on August the 11th. We then proposed to visit Abagaitui in Siberia by way of Dalai Nor, but our guide informed us that this was impossible, as it would mean crossing a mountainous district where there was no water. On the following day, therefore, we decided to return to Manchouli, which we reached on August 14th. From this date until August 25th we lived at Manchouli, making excursions into the country around and doing experimental work with Tarbagans.

On August 25th I departed from Manchouli in order to enquire into an outbreak of Plague which was reported from Puk'uei (Tsitsihar, capital of Heilungkiang Province) and from thence went back to Harbin. I left Dr Ch'en at Manchouli to finish our work there and

<sup>1</sup> Borsja is 121 versts west of and three hours by express train from Manchouli.

to make any other investigations that might be required. Dr Ch'en's work at this time is incorporated in this Report. He left Manchouli for Harbin on September 30th, 1911, as the evenings were getting too cold for further stay in camp.

### III. MANCHOULI<sup>1</sup>.

The principal marts in the Manchurian Provinces for Tarbagan skins are Manchouli and Hailar. Hailar is 116 miles (174 versts) by rail east of Manchouli station, but as the latter is the only Customs station for the district, skins sold in Hailar have to be sent there for exportation. The chief Russian mart is Borsja (Transbaikalia), some 80 miles (121 versts) west.

Manchouli is situated in Chinese territory at the junction of the Chinese Eastern and the Trans-Siberian Railways, and is about ten miles east of the frontier between the Province of Heilungkiang and Siberia. Here are established the Chinese and Russian Customs for the examination of goods and baggage passing along the railway from one country to the other—Manchouli having been opened as a Customs station in February 1907. Most of the information which follows about the place was obtained when I visited the town at the end of May and again in August.

Manchouli (meaning the hamlet of the Manchus) lies 2600 feet above sea level and is surrounded on all sides by low barren mountains. The water is saltish, hard and scarce. The railway zone covers a large area and consists of four sections:

(1) The Private Settlement containing 5000 Russian and 1500 Chinese inhabitants.

(2) The Chinese Eastern Railway Settlement containing about 700 inhabitants, mostly Russians.

(3) The Transbaikal Settlement containing 800 inhabitants.

(4) The River Settlement on the further side of the "river"—a shallow ditch some five feet wide. This Settlement used to be occupied by desperadoes and murderers, mostly Caucasians, who carried on a trade in smuggling. It is now in ruins, having been destroyed five years ago by the Russian police who, after a three days' fight, caught and exiled the survivors to Siberia.

Altogether the population of Manchouli may be estimated as consisting of 8000 Russian civilians, Customs officials, etc., 3000 Russian

<sup>1</sup> Manchouli is 875 versts or 583 miles by rail west of Harbin.



troops, and 2000 Chinese, most of whom are of the coolie class. During the Russo-Japanese War there used to be as many as 40,000 to 50,000 people resident at Manchouli.

*Occurrence of Plague at Manchouli and surrounding districts.*

In 1898 Prof. Zabolotny was in Mongolia and found Plague in the region he visited. Between this date and 1905 I could gather no reliable information as to the occurrence of the disease in or around Manchouli. Dr Bissemsky, the Russian physician in charge of the railway at Manchouli, supplied me with the following interesting information regarding outbreaks of Plague which had occurred in his district since he went there in 1905:

- 1905. Plague occurred in August at Dalai Nor<sup>1</sup> (14 cases) and in Manchouli (4 cases). Total 18 cases. Bubonic type.
- 1906. Plague occurred in Abagaitui<sup>2</sup> (Russian territory) (15 cases) and in Manchouli (2 cases). Total 17 cases. Pneumonic type.
- 1907. One case was imported from Transbaikial territory into Manchouli. Bubonic type.
- 1908. There were no cases of Plague in Manchouli, but there was reason to believe that the disease was present among the Mongols along the Argun River. There is some doubt as to the type of the disease, but it seems probable that it was pneumonic.
- 1909. No cases reported.
- 1910. The last epidemic, with 400 cases at Manchouli. Pneumonic type.

To bring it up to date, the above information may be supplemented as follows:

- 1911. End of August, 5 cases at Scharasone, 4 deaths. Bubonic type.
- 1912. Beginning of September, near Chita<sup>3</sup> (capital of Transbaikalia), 3 cases, all fatal. Evidently pneumonic type (confirmed by P. Haffkine).

In regard to the above outbreaks, it is interesting to note that those of 1905, 1906, 1907, 1911 and 1912 were confined to Russians and Cossacks, no Chinese having died: whilst in 1908 only Mongols died.

<sup>1</sup> Dalai Nor is the first railway station, 28 versts east of Manchouli.

<sup>2</sup> Abagaitui is 20 miles north of Manchouli.

<sup>3</sup> Chita is 447 versts N.W. of Manchouli.

In the epidemic of 1910-11 both Russians and Chinese were attacked, but mainly the latter; of 400 fatal cases at Manchouli only about 15 were Russians, and these were mostly hospital attendants. For some reason which we cannot explain, during the epidemic of 1910-11, the Russians escaped even when some of them lived with Chinese coolies who took the Plague. In considering the occurrence of Plague at and around Manchouli, it must be borne in mind that the disease is endemic in the Kirghiz Steppes<sup>1</sup>, and from time to time this has travelled eastwards giving rise to sporadic outbreaks in Eastern Siberia.

This subject has been treated carefully in a series of articles written by the British Delegate to the Constantinople Board of Health<sup>2</sup> and by the Russian, Dr Koltshof<sup>3</sup>, quoted by the British Delegate. So important is the subject in reviewing the occurrence of Plague in Manchuria that I quote these articles at some length. For convenience the subject has been considered more or less in chronological order.

Koltshof gives the following summary of the epidemics in the Bukeëf Horde of the Kirghiz Steppes of the Astrakhan government during the twelve years preceding 1911. The disease generally gives rise to two annual epidemics—one in summer, the other in winter.

- 1898. Up to this year there are said to be no records of Plague in the Bukeëf Horde.
- 1899. Summer, no outbreak. Winter, 1899-1900, epidemic began on November 15th.
- 1900. Summer, no outbreak. Winter, 1900-1901, epidemic began on December 23rd.
- 1901. Summer, no outbreak.
- 1902. Summer, epidemic began on June 3rd.
- 1903. No Plague in the Horde, though epidemic elsewhere in the Astrakhan government.
- 1904. In December, imported from Kirghiz and Cossacks in the Uralsk Province, where 415 persons had died.
- 1905. Summer, some minor outbreaks. Winter, an exceptionally severe epidemic. From October 13th to February, 1906, some thousand persons lost their lives.

<sup>1</sup> The Kirghiz Settlements are situated in the governments of Astrakhan (Europe), Uralsk and Semiretchinsk (Asia). The area covered by these three governments is a very large one.

<sup>2</sup> *Lancet*, April 24th, 1909, Jan. 7th, 1911, June 3rd, 1911, March 9th, 1912.

<sup>3</sup> *Vratch*, No. 35, August 27th, 1911, quoted in *Lancet*, March 9th, 1912.



1906. Summer, epidemic began on April 15th. Winter, epidemic 1906-7 ended on February 28th.
1907. Summer, epidemic began on July 26th. Winter, epidemic began on October 11th.
1908. Summer, epidemic began on July 7th and ended August 3rd. Winter, no outbreak.
1909. Summer, no outbreak. Winter, 1909-10, epidemic began end of October and subsided in February.
1910. Summer, epidemic began on June 15th.

In Odessa, from May 22nd to August 28th, 1910, there were 97 cases of Plague of which 24 were fatal; and at the beginning of October, 1910, there were four cases.

In July, 1910, Plague appeared in the Kirghiz Steppes, namely in the Asiatic province of Semiretchinsk and in two villages of the Abbastin quarter in the Prjevalsk district of that province, there were 17 cases of pneumonic plague, all fatal, between July and August 11th. No further information regarding this outbreak has been published.

In the Uralsk government, in the five villages of the Jambeitinsk district, between August 10th and 14th, there were seven cases of plague, with three deaths. It should be noted that the dates given above are according to the Old Style calendar, which is 13 days later than the Gregorian.

Concerning the outbreak of pneumonic plague at Manchouli in the autumn of 1910, the following occurs in Dr Ch'uan Shao-ching's paper read at the International Plague Conference<sup>1</sup>:

"Observations reported to me by Chinese residents (at Manchouli) show that two carpenters who lived in the house adjoining Wu Kuei-ling's inn died with spitting of blood on the 10th day of the 9th Moon (October 23rd). These two carpenters had been in the service of a foreman named Chang Wan-shun at Dawoolya (Daurija), a railway station in Siberia situated some six miles west of the boundary line. Chang Wan-shun told me that six or seven of his carpenters had died with blood spitting in Dawoolya on the 13th day of the 8th Moon (September 26th) and said he believed that plague had appeared in Dawoolya before it was known in Manchouli.

"Later on it was found that nine out of twenty coolies, who lived in a small room in Wu Kuei-ling's inn, were suddenly taken ill with blood

<sup>1</sup> *Report of the International Plague Conference*, p. 28.

spitting. One of them was sent to the Russian Plague Hospital, and it was discovered that he suffered from pneumonic plague. Two died in the house that same night, but the rest ran away to different places in the town, and thus disseminated the disease."

Returning to the articles already referred to in the *Lancet*:

"On October 14th, 1910, 17 deaths from pneumonic plague occurred in the village of Akurai in the district of Chita. During the week ending October 28th, 1910, there were four deaths at Daurija station, two cases at Tarbagatui mines near Petrovsk, and 34 cases at Manchouli.

"In the early part of 1911, Plague was still prevalent at the Kirghiz Steppes. In and near Sartube (in the first Maritime District), there were 31 cases with 29 deaths between January 4th and 20th. At Djaltir, also in Astrakhan government, seven persons in one hut fell ill with plague (February 3rd to 7th) and three died.

"During the latter part of 1911, outbreaks of plague of greater or lesser extent occurred in various Kirghiz settlements, the disease being particularly active in the Astrakhan government. In the Semiretchinsk government, which is situated close to the Mongolian frontier and to the north of Kashgar<sup>1</sup>, plague appeared on August 31st (Old Style) in the Kirghiz settlement Akskoe in the *volost* of Tcherikof. By September 14th there had been four cases, all fatal, of pneumonic plague. From Prjevalsk, on September 14th, were reported eight fatal cases of the same disease at a spot near Maryn in the same *volost*, and two more deaths occurred there on September 16th. By September 20th the epidemic was declared to be at an end.

"In the Uralsk government, situated much more to the west and adjoining the Astrakhan government, five deaths from pneumonic plague occurred in the Uletinsk *volost* before August 10th. In the same district, in the Turkoman settlement, near Djambent, eight fatal cases of pneumonic plague were recorded between June 29th and August 8th. In the Tchadyrtinsk *volost* of the same government, eight cases and three deaths from plague of the 'pneumonic and abdominal forms' occurred before September 10th, followed by one death on the 12th, and one fatal case on the 13th. Another case occurred in another settlement five versts away, and the totals by September 16th had reached ten cases and six deaths.

"In the Astrakhan government, plague was epidemic in the Urotchishche of Saganai from the end of August to middle of September; a score or more cases occurred here. On September 21st the disease

<sup>1</sup> Capital of Chinese Turkestan.



became epidemic in several other centres. The following table is a summary of the returns :

Period	No. of infected centres	Cases	Deaths
September 21st—Nov. 7th, 1911	16	73	63
„ „ — „ 21st, „	28	120	102
„ „ — „ 28th, „	33	139	119
„ „ —Dec. 19th, „	38	187	166
„ „ — „ 26th, „	43	201	180

“The infected centres were situated principally, if not entirely, in the Marynsk, the Kamysk-Samara, and the Primorskaia (or Maritime) divisions of the Astrakhan Steppes. The disease was most active in the Ak-tchagyl settlement (15 versts from the above named Saganai), and in those of Sarhube, Kudauysk, Djapalatka, and Autantchagyl. Elsewhere but few cases or deaths occurred in any single centre. While many of the outbreaks were pneumonic in character, this was not invariably the case<sup>1</sup>.”

“From Oct. 1911 to Feb. 1912, over 200 cases occurred in the Kirghiz Steppes; among the deaths from plague in the Astrakhan government were those of Dr I. Deminsky, a bacteriologist, and his student assistant. In the port of Kherson on the Black Sea a plague-stricken rat was found in September on a ship which had arrived from the port of Odessa, and this gave rise to a suspicion that the latter port had not yet got rid of the epizootic which was formerly reported among its dock rats.” *Lancet*, Dec. 28th, 1912, p. 1811.

#### PROHIBITION OF TARBAGAN HUNTING.

During February 1911, the (Chinese) Prefect of Manchouli prohibited the hunting of the Tarbagan, the penalty for disobeying this order being two months' imprisonment. In the following April a further order increased the punishment to six months' imprisonment (Appendix III). Up to June 1911 several Russian and some twenty Chinese hunters had been arrested and since then no one had been found hunting. The Chinese suffered imprisonment, and the Russian hunters were handed over to the Russian authorities. The punishment meted out to these Russian hunters is believed to have been confiscation of traps and of half of the skins found, the other half being returned after disinfection to the offenders.

On August 11th, 1911, a General Order, No. 26, was issued by the Russian authorities forbidding trade in Marmots, including hunting of

<sup>1</sup> British Delegate to Constantinople Board of Health, *Lancet*, March 9th, 1912.

animals, preparation of skins, salting of the flesh and fat under penalty of a fine of 500 roubles or three months' imprisonment. From enquiries made from the Russian police at Manchouli on August 21st it appeared that they had read of the Order but up to the time had not received official notice of it from the Head Office in Harbin. Consequently they were not empowered to put any hindrance on the trade in Marmot skins, although since the beginning of the year they had required, before granting permission to export, a formal guarantee that the raw skins had been sent to the local railway doctor for disinfection. How this disinfection had been carried out, or if it could be carried out at all, without spoiling the skins, was not known.

Up to 1908, comparatively few Chinese hunted the Tarbagan. In the autumn of that year and in the autumn of 1909 several thousand Chinese, attracted by the high price paid for the fur, were in the neighbourhood of Manchouli, and in 1910 the number reached 10,000 hunters.

Owing to the Chinese Order prohibiting the hunting of Tarbagans, there were fewer Chinese in Manchouli during 1911 than formerly, and in consequence the low class so-called lodging-houses, which used to be occupied by the hunters, had been left almost empty. The camping grounds just outside the town where the Mongol hunters used to erect their tents during the hunting season were also deserted.

### THE INNS.

The inns are of two kinds—those entirely underground and those partly overground and partly underground. The overground dwellings are brighter since they are more open, by means of windows made either of glass or paper, to the sunlight, but those partially underground are more popular in cold weather because of their greater warmth<sup>1</sup>. The windows of the latter appear just above the ground and their roofs are made of mud. The accommodation in both types of inns is based upon much the same plan. Two, and sometimes three, tiers of berths for the lodgers are present, there being just room enough between the tiers for a man to sit up. In one house I visited there were 40 berths—20 above and 20 below—the measurements of the room being only 25 ft. square and 14 ft. high. Even in May the rooms were ill-ventilated and stuffy. In winter when all the windows are closed and the fires are lit

<sup>1</sup> In winter the outside temperature as a rule reaches  $-30$  to  $-40^{\circ}$  C., and the ground is frozen to a depth of over 6 to 8 feet.





Fig. 1. Some of the inns at Manchouli. The structure seen on the right is the entrance to one of the underground type.



Fig. 2. Interior of an underground inn at Manchouli showing lower tier of berths. To take this photograph, it was necessary to lie at full length on one of the upper berths.





the stuffiness must be great. Dr Ch'uan visited some of these inns in the winter. His report showed the conditions to be bad in the extreme: in one hut, 15 ft. square and 12 ft. high, there were packed in three tiers of berths, one above the other, more than 40 people. The windows were closed and there was a heating stove in the middle of the room. The odour was indescribable, being made up of a mixture of foul breath, the vapours of old dirty fur garments and decomposing pelts which were lying alongside the men (Pl. I, figs. 1, 2). The usual way of heating these inns is by means of a *k'ang* on either side of the central passage leading from the door. A *k'ang* is a horizontal brick flue about 5 ft. wide and 2 ft. high, at one end of which is an opening where is lit a fire of wood or *Kaoliang* (millet) stalk. At the other end of the *k'ang* an opening is made through the outside wall of the house, and leads to a chimney for the escape of the smoke. *Kaoliang* stalk is cheaper than wood and hence is usually used in poor houses; the heat produced is not very great but is sufficient to keep the room at 2 to 5°C. even when the thermometer outside registers - 20°C. The windows are few in number, and usually made of a wooden framework pasted with white paper, thus keeping in the heat but allowing little sunlight to penetrate. The men eat, sleep, and very often cook in the same room. They sleep in rows with the head against the wall and the feet towards the central passage. There is no partition between adjoining berths so that they can easily breathe and cough into each other's faces. Their food consists mainly of millet bread, boiled cabbage, and boiled turnips; they have meat perhaps once a month. For board and lodging the hunter pays at least fifteen roubles a month; in busy times, more. The winter clothes usually consist of a pair of padded cotton trousers, padded socks and thick-soled Chinese shoes, two or three layers of body clothing and a long cotton-padded gown reaching to the ankle. In very severe weather they wear in addition long sheepskin garments and fur caps. During winter the men seldom change their clothes which abound with insects, *e.g.* lice, fleas, but in summer they lay aside their thick outer garments and wash the inner ones, using them alternately. Unless very poor, the winter trousers are then replaced by thinner ones which cost about a rouble (2s. 1d.) each.

In these inns I have found coolies from Shantung and Chihli, Manchus and Mongols; in addition, the hunters consist of Buriats and Cossacks. These unhealthy huts are owned by Russians and were built originally for their poor class nationals, but perhaps they were never so overcrowded as when Chinese occupied them.

From 1908 to 1910, so many people came to the districts to hunt the Tarbagans that the owners of the inns did a roaring business and packed the men in every available space, extra tiers being added whenever possible above those already existing.

It should be remarked that the number of Mongols regularly resident at Manchouli seldom reached a dozen ; but at certain times of the year, especially in summer, large caravans consisting of whole Mongol families pitched their tents on the vacant space in front of the *Yâmen*<sup>1</sup>. At the time of my visit in July 1911, there were nearly fifty families (some 150 people in all) thus encamped. Some lived in tents, others inside their rickety carts. These vehicles have no springs and no metal rims to the wheels. On such occasions the Mongols brought with them for sale horses, cattle and sheep as well as skins. They were very orderly and willingly abided by the rules laid down by the Prefect.

At Manchouli there is a General Hospital under the charge of the Russian doctor Bissemsky. This hospital has accommodation for 40 in-patients as well as separate blocks for infectious diseases and plague. There are besides a post-mortem room and quarters for the attendants.

#### *Proposed Chinese Hospital at Manchouli.*

Soon after the International Plague Conference it was decided to build a plague and a quarantine hospital at Manchouli, and the necessary funds amounting to Tael 40,000 (about £5600) were sanctioned by the Central and Manchurian Governments in May 1911—these funds coming from the surplus of the Plague Prevention Funds which had been voted during the epidemic of 1910–11. The hospital was to have accommodation for 20 plague cases, 20 suspect cases and 150 contact cases, and was to be in charge of a Senior Medical Officer with European degrees resident permanently with a trained staff. Plans had been submitted and selected and the foundations had been dug out in a vacant piece of ground near to the *Yâmen* of the Prefect. As Manchouli was so isolated, it was proposed that the bricks should be made locally. By October, 1911, the stones and timber had been carted to the site and a well dug. Winter setting in necessitated the work being stopped temporarily. Soon after came the Revolution in China, followed in January 1912 by the troubles in Mongolia. Among the things destroyed at Manchouli by the Mongols were the schools, the *Yâmen*, and even the foundations and materials intended for the new hospital.

<sup>1</sup> A *Yâmen* is a Chinese official's residence or place for transacting official business.



*Note on the Fur Trade at Manchouli.*

The Tarbagan hunting is divided into two seasons :

(1) The Spring season lasting from the end of April to the beginning of June.

(2) The Autumn season lasting from the middle of August to the end of September.

The early Spring fur, owing to its being lighter in weight, is more valuable than the heavier fur obtained in the Autumn season. The fur of the Tarbagan is thick, soft and very serviceable in winter ; but up to five years ago the export was not great. Then came a big demand from Europe and America, for the fur dealers in London and Leipzig found that if properly cured and dyed, these furs could be turned into imitation sable and seal skins. The following are the Chinese Customs Returns showing the number of skins exported from Manchouli on which duty was charged during the years 1908-1912 :

Pieces of	1908	1909	1910	1911	1912	Value in Customs Taels for 1912 (1 Customs Tael =Rouble 1·60)
Fox skins	407	3,502	4,378	638	1,274	Tls. 5,096
Goat skins	3,770	2,454	4,829	1,929	1,445	—
Sable skins	920	9,039	4,729	66	62	„ 1,530
Sheep skins	238,479	214,104	193,147	49,689	135,278	—
Squirrel skins	26,234	12,983	29,043	3,080	102,312	—
<i>Tarbagan skins</i>	210,224	19,181	242,458	10,673	55,196	„ 15,769
Total no. of furs	480,034	261,263	478,584	66,075	295,567	
Percentage of Tarbagan skins to total no. of skins	44 %	7·3 %	50·6 %	16 %	18·7 %	

The above figures, however, do not give an adequate idea as to the actual total export of furs from Manchouli, since many skins, as well as hides and bristles, were consigned to Mazijewsskaia, the first station on the railway west of Manchouli and within the 50 verst<sup>1</sup> duty free zone<sup>2</sup>. Duty was not collected on these furs, the excuse being made that they were for use within the 50 verst free zone. It is estimated that in 1910, two million Tarbagan skins in all were exported from Manchouli. In June 1913 over four million Tarbagan skins were lying at Manchouli ready to be carted by road to Mazijewsskaia for export to Europe. In

<sup>1</sup> 3 versts = 2 miles.

<sup>2</sup> By the Treaty of 1881 made between China and Russia, it was agreed that within a zone of 50 versts on either side of the frontier between the two countries, goods shall be admitted free of charge.

weight it is estimated that 1000 Spring Tarbagan skins weigh 8 Russian *poods* (288 English pounds); whilst 1000 Autumn skins weigh 14 *poods* (504 English pounds), counting a *pood* as 36 pounds. The price rose rapidly from 15 kopecks to 50 kopecks per skin until in 1910, 80 kopecks per skin were realised.

Owing to the increased demand for skins and the consequent rise in price large numbers of coolies—and especially those from Shantung—were attracted to the spot, and the agricultural peasants left their fields to become Tarbagan hunters. By three months' hunting of the Tarbagans they were able to make as much money as they could have done in the course of a whole year from other occupations.

The Tarbagan skins are mostly sent to Leipzig and London to be cured. At the former town there is a large well-equipped factory for converting the skins into imitation-sable. Of late years, for greater safety, valuable furs have been sent to Europe by parcel post.

#### IV. PROFESSOR ZABOLOTNY'S WORK AT HARBIN.

When I visited Harbin in May and again in July, I called on Professor Zabolotny who was working there at certain problems in connection with plague. I believe that a full account of these has been published already, but it is not available to me. As some of his results and the information he had received influenced to a certain extent our future plans, it seems wise at this point to refer briefly to his results as given to me at that time:

I. He confirmed the fact that the cultures obtained from the donkey at Mukden were *Bacillus pestis* (see *Report of the International Plague Conference*, pp. 143–4).

II. His experiments on the infectivity of animals had given interesting results, viz.:

(a) Two donkeys, inoculated subcutaneously with cultures of *Bacillus pestis*, took plague badly but did not die<sup>1</sup>. These were later on allowed to inhale large numbers of the bacilli through tracheotomy wounds, but both animals resisted the disease. When I saw these animals they were apparently quite healthy and playing about in the field.

(b) Pigs were successfully infected and died.

<sup>1</sup> Cf. Strong and Teague. From experiments performed by them, they consider that donkeys are *not* susceptible to pneumonic plague infection (*vide Philippine Journal of Science*, Sec. B, Vol. VII. pp. 225–7).



- (c) Dogs took the disease but did not die.
- (d) Other animals took plague easily.
- (e) Birds were immune.

III. Zabolotny had obtained most interesting results from experiments conducted on 18 monkeys. He tried to protect them with vaccines and serum in large doses, but only two were saved, and these had received extraordinarily large doses. For instance he carried out the following series of experiments:

	Monkey <i>a</i>	Monkey <i>b</i>	Monkey <i>c</i>	Monkey <i>d</i>
1st injection (emulsion of dead agar culture)	1 c.c.	4 c.c.	5 c.c.	25 c.c.
2nd „ „ „ „	2	5	10	30
3rd „ „ „ „	3	5	10	—
Result after inhaling <i>B. pestis</i> through tracheotomy hole	Died	Died	Died	Ill for 1 week, then recovered

IV. If monkey *d*'s example is one to be followed for man, it would mean that at least two doses of 250 c.c. and 300 c.c. respectively of the emulsion would be required to produce immunity (taking a monkey's weight to be 6 kilos and the weight of a man 60 kilos). Three monkeys were also treated respectively with 100 c.c. of serum prepared in (a) Kolle's Laboratory, (b) the St Petersburg Laboratory and (c) L'Institut Pasteur in Paris. Only one survived the inhalation experiment, namely, the one treated with the Paris serum.

In a series of experiments, strains of *Bacillus pestis* from Mongolia (1898), Odessa and Bombay—all bubonic cases—were used for inhalation experiments. Death from pneumonic plague resulted, thus proving the similarity of the micro-organism in both types of the disease.

In another series, the experiments were reversed. Strains from Harbin and Mukden (pneumonic cases) produced the bubonic type of plague when inoculated subcutaneously.

V. Some weeks previous to my visit in July, Zabolotny had persuaded the authorities to allow cremation of all bodies dead from Plague which had been buried at Harbin during the previous winter, including those of the Doctors and Sanitary Staff. From 15 of these he removed the heart's blood for cultures and examination purposes. Results positive for *Bacillus pestis* were obtained in 10 out of 15 cases, including those of three doctors and two students. The soil surrounding the coffins, 2½ metres deep, was still frozen. These bodies were afterwards cremated and the ashes laid back again.

VI. A Tarbagan caught on June 24th by Dr Issaief near Scharasone on the Siberian side of the border was suffering from



Plague, and died soon afterwards. Zabolotny showed me the organs of this animal. There were marked signs suggesting Plague in the spleen, lungs (hæmorrhages) and there were cervical buboes. Growths obtained from the organs gave pure cultures. From one of the cultures thus obtained, Zabolotny inoculated in Harbin a healthy Tarbagan on the right leg and produced two large buboes in the right groin only. This animal died of septicæmia.

VII. Four other Tarbagans were suspected to have died of Plague. These had been found:

- (a) near Scharasone also by Issaief and Zabolotny,
- (b) at Arabulak south of Charbada (Mongolia) by Bissemsky,
- (c) at Kulussutai in Transbaikalia by Krestovsky,
- (d) at Borsja (121 versts west of Manchouli) by Bissemsky.

At the time when I met Zabolotny the diagnosis of these four cases was not complete. Later, however, it was found that none of the cases were Plague.

VIII. During July, Zabolotny had received reports of large numbers of Tarbagans dying north of the River Borsja in the neighbourhood of Kerulen. We decided to equip a joint scientific expedition and visit the spot without delay.

#### V. WORK AT BORSJA. July 22nd–29th, 1911.

(Plate II.)

Borsja (Siberia) is 121 versts west of Manchouli on the Railway and is the centre of Tarbagan hunting in the Transbaikal district. During our stay there, no hunting was being carried on as this had been forbidden. There were some 200 to 300 Chinese engaged in small business; usually these depended on the Cossack hunters.

On the morning of July 22nd we arrived at Borsja, and joined Professor Zabolotny and his staff. The accommodation consisted of three railway cars:

- (a) a car fitted up for our living quarters;
- (b) a laboratory car fitted up with incubators, sterilisers, etc., and having a compartment in which post-mortems on animals were to be performed;
- (c) an animal car containing about 40 cages in which Tarbagans could be kept for observation. These cages were mostly oblong and were made of thin iron sheets and ventilated by means of round apertures punched in their sides.

Special permits to hunt were given to skilled Russian hunters who were specially instructed to bring in any sick Tarbagans. For healthy animals we offered one rouble and for sick ones five roubles.

Forty Tarbagans were kept for observation in the cages; when we had satisfied ourselves that they were perfectly healthy they were released and others put in their place. In this way about 80 Tarbagans came under observation. During the week we spent at Borsja, no sick Tarbagans were brought in and none of those under observation showed any sign of disease. On the day of our arrival at Borsja we performed post-mortems on five Tarbagans and found all of them healthy.

Prof. Zabolotny, Dr Ch'en and I drove in carts and also walked over the whole neighbourhood, visiting particularly the places where sick and dead animals were reported to have been found in large numbers.

On July 24th we drove to Tschintansk, a village south-west of Borsja. There were plenty of Tarbagans on the way and we stopped and examined the country at different stages of the journey, but could find no trace of sick animals.

The driver of our *drosky* had been in these parts for the last 27 years. He informed us that as early as 1884 Tarbagans had died from an epidemic in this neighbourhood and that one day a Russian doctor and his dresser, stationed at Akscha, performed a post-mortem examination on a hunter who had died under suspicious circumstances. They were both taken ill, and two days after performing the post-mortem, died in this man's *drosky* whilst trying to get back to Akscha. He remembered that both were exceedingly short of breath. Unfortunately for the veracity of this account, our *isvostchick* was very fond of vodka as we experienced after leaving Tschintansk—he driving very recklessly, and eventually dashing up a high bank and upsetting the carriage on the top of us! From Tschintansk we went to Arabulak—a “village” consisting of one solitary post-house and looked after by a Cossack family. Here we stopped overnight. The country between Tschintansk and Arabulak as well as the high hills surrounding the latter place abounded in Tarbagans. Our party divided up and we inspected hundreds of holes but found no trace of sick or dead animals—not even Tarbagan remains being seen.

On the following morning we got up at 4 a.m. to see if the Tarbagan came out from its hole at dawn seeking food as some believe to be the case. But during the next six hours we did not see more than five Tarbagans. We then returned to Borsja.



In the afternoon (July 25th) we went out all around the neighbourhood of Borsja, and although we inspected many holes, no trace of a sick animal was found. On July 27th a dead Tarbagan was found four versts away. We judged the animal to have been dead some 48 hours. The lymphatic glands were dark in colour but not enlarged, whilst the spleen was double its normal size. Full bacteriological examination, however, did not reveal any *Bacillus pestis*.

On July 29th we all returned to Manchouli, it having been decided that the Chinese Expedition should pursue further investigations in Mongolia. While at Borsja we performed experiments to try and ascertain if cannibalism was common among Tarbagans. In one of these an animal was starved; after some days a dead animal was introduced into the same cage but at the end of five days the carcass had not been mutilated. I wish to take this opportunity of expressing my indebtedness to Prof. Zabolotny for his unfailing courtesy on all occasions when I had the pleasure of being associated with him.

#### VI. MANCHOULI. July 29th–August 3rd, 1911.

After our return from Borsja to Manchouli Dr Adolphe, surgeon to the Railway, informed me on August 1st that three dead bodies had been found eight days previously some seven versts from the town. Having obtained further particulars from the President of the Russian Municipal Council, accompanied by Dr Adolphe I visited the spot. The way was past the old burial ground where six Russians and 400 Chinese dead of the Plague epidemic during the last quarter of 1910 had been buried in a long U-shaped trench six feet underground. After prolonged search we came across some human remains about two miles from the burial ground. The remains consisted of one skull, the bones of the thorax and a few bones of the limbs; in addition rags and clothes were scattered about. There were also planks—the remains of coffins—and three holes where these coffins had evidently been buried. There were also inscriptions in Chinese, from which we learnt that the men were Chinese and had died on the 14th, 15th and 21st of the eleventh Moon (about the end of November)—this corresponding to the period when Plague was prevalent at Manchouli. On the following day, accompanied by the Chinese Prefect, I returned to the place and after a further search found some more bones but no skulls. We collected the remains together, burnt them, and buried the ashes. Slides and cultures taken from the flesh still adhering to the skulls revealed no *Bacillus pestis*.

VII. WORK IN MONGOLIA. August 4th–13th, 1911.

On August 4th we left Manchouli for Mongolia. Our party and equipment consisted of:—

- Three medical men—Drs Ch'en, Tsang and myself;
- One Interpreter who spoke Russian, Mongol and Chinese;
- One Sergeant and six mounted Policemen (Chinese);
- One Finn Tarbagan hunter; this was the hunter who caught, in the previous April, the 12 Tarbagans for the International Plague Conference;
- Two carriages;
- Three carts for tents, baggage, provisions, etc.;
- Nineteen horses and ponies.

Our laboratory equipment consisted of two microscopes, *media* ready for use, traps and snares for Tarbagans, cages, apparatus for experiments with fleas, etc. The weather was good all day and in the evening we encamped at Tarbagan Ta Hu, 30 *li*<sup>1</sup> south-west of Manchouli. The water in a lake close by was briny and we had to depend on the stock brought with us. Here swarms of mosquitoes were encountered.

*Mosquitoes.*

Tarbagan Ta Hu, 30 *li* south-west of Manchouli, August 4th, 1911, near a small lake of briny water.

Mosquitoes present in enormous numbers, the air being black with them. The gauze covers around our hats were of no avail as the insects covered them making it impossible to see, and owing to their having long proboscides they were able to attack the face. I collected some hundreds of mosquitoes and found them to be:—

- (1) *Culex* principally, and
- (2) *Anopheles maculipennis*.

(These were afterwards confirmed by Professor Nuttall of Cambridge.)

Later I found that the Mongols complained of fever, and since *Anopheles* was present in this neighbourhood, one presumes the disease to be malaria. Some Mongols seen during our expedition were suffering from what was undoubtedly malaria clinically, and the disease responded to treatment with quinine.

<sup>1</sup> 1 *li* =  $\frac{1}{3}$  mile.



## CHARBADA.

On the following day, August 5th, we reached Charbada—a village 63 *li* south-west of Manchouli. The country *en route* showed nothing but long grass and Tarbagan mounds. The village is made up of a few huts occupied by about 20 Mongol families numbering under 100 souls. As soon as the grass has been cleared by their large droves of horses, cattle, and sheep, they move their dwellings to other places. (For our observations on the Mongols, see p. 31.)

From enquiries made among these Mongols, I learnt that there had never been any outbreak of disease resembling human plague in their midst. Nor could I obtain any word of disease among the Tarbagans: the country in which they had lived for many years past abounds in Tarbagans, yet they had never noticed the animals dying.

We ourselves laid traps and caught several Tarbagans, but none of them showed any signs of disease. We scoured the neighbourhood for remains of the animal, *e.g.* bones, skulls, carcasses, but could find none. Leaving Charbada we made our way backwards along the banks of the River Kerulen, and arrived at Kulun See—a large shallow lake of semi-alkaline water. On the way we found many good camping grounds where there was fresh water. At many such places we found collections of Tarbagan skeletons, each numbering from 50 to 80 sets of bones, lying in heaps—evidently the remains of animals which had been skinned by the hunters who had afterwards thrown away the carcasses. At Kulun See we camped with another colony of Mongols. Here again we could get no history pointing to Plague either among the Mongols or among the Tarbagans. In the country around, although plenty of Tarbagan holes were met with, few of the animals were seen, and our traps seldom caught any. The country had been used for pasturage by the Mongols and large stretches had been fired. From this it would seem probable that, when food becomes scarce in one region, the Tarbagans migrate to regions where food is plentiful.

From Kulun See we proposed to go to Abagaitui (Siberia) by way of Dalai Nor<sup>1</sup>, but our guide informed us this was impossible as it would mean crossing mountains where there was no water. We, therefore, returned to Manchouli, reaching there on August 31st.

<sup>1</sup> Dalai Nor is a village 28 versts east of Manchouli and contains a coal mine supplying coal to the Railway.





Fig. 3. The Chinese and Russian Expeditions. Borsja (Siberia), July 22nd-29th, 1911.  
Two of the railway cars used by us are shown in the photograph.



Fig. 4. A Mongol family and hut. Charbada.





*The Mongols.*

(Plate II, fig. 4.)

At Charbada and Kulun See we camped with Mongols and thus had opportunities of studying them and their habits. The Mongols at Charbada were apparently quite wealthy though they lived in a most primitive way.

The huts are round and domelike measuring about 15-20 ft. in diameter and consist of a series of moveable wooden frameworks  $4\frac{1}{2} \times 2$  ft. in size, oblong in shape, and covered by felt matting made of camel's hair or sheep-skins. On the floor is laid felt matting on which the inhabitants sleep. The furniture consists of a few wooden chests where clothes and money are kept, a Buddhist shrine, a cooking pan and stove, and a box containing dried cattle-dung which is used as fuel for cooking and heating purposes. The same pair of tongs used for the dung is employed in their cooking operations.

The Mongols drink a large quantity of cow's and goat's milk and they eat, besides mutton, a good deal of Tarbagan flesh which is only half roasted before the primitive fire. There were some children in the camp at Charbada; these, and likewise the children seen at Kulun See, were clothed in rags and were indescribably dirty. All the people looked healthy, however, in spite of their peculiar mode of living. The Mongols are a simple contented people. They informed me that if more than one son were born in a family the other sons must become *lamas* (priests). Hence the population has decreased enormously during the last 200 years. While the men tend their flocks, the women look after the homes. A large percentage of those whom we encountered had passed their 60th year, and one old man was at least 80. Doubtless the open air existence with the dry atmosphere preserves these people remarkably well in spite of the trying weather, but at an early age their faces show signs of toil. They were very hospitable and willingly supplied us with milk for which they declined to be paid. Their carts appeared crude and rickety, having no metal rims around the wheels, or metal work at the joints: yet they seemed to answer the purpose well.



VIII. THE TARBAGAN OR MARMOT. (*Arctomys bobac*, Schreb.)

(Plates III–V, figs. 5–9.)

The Russians call this Marmot “Szuriok” and the Chinese “Han T’a”; but the name most familiar is the one adopted by the members of the International Plague Conference, namely “Tarbagan”—a term derived from the Mongols.

The Marmots belong to the group of simple-toothed Rodents which include Squirrels, Rats, Mice and Porcupines.

The particular species of Marmot found in Manchuria and Mongolia is identified as *Arctomys bobac*, Schreb. (or the true Marmot).

The following are some of its distinguishing features:—

1. The body is stout and the limbs are short.
2. The tail is bushy and comparatively short, being about one half the length of the body.
3. The head is wide and short and there are no cheek pouches.
4. The eyes are large and full.
5. The ears are small and more or less rounded.
6. Of the five toes, the thumb is rudimentary, being supplied with a flat nail, whilst the claws of the remaining four are long and exceedingly sharp.
7. The rows of molar teeth are placed nearly parallel to each other, both in the upper and lower jaws.
8. The fur is of moderate length and of a fine texture. The general colour tends to change at different seasons of the year, varying from a light greyish brown in the spring to a reddish brown hue in the late autumn. On the back and around the eyes the fur is darker in colour.
9. The length of the adult animal exclusive of tail varies from 15 to 18 inches (37 to 45 cm.).
10. The weight of the adult animal varies from 9 to 12 lbs. (4100 to 5400 grammes), being greater as the hibernating season approaches.

After returning to Manchouli from Mongolia, a series of morning and evening temperatures were taken on these animals by us (see Appendix I, pp. 50, 51). The temperature taken *per rectum* presented wide variations in different animals and in the same animal at different times—even in apparently perfect health. Thus, in some it was found to be 95° F., in others 96° F., in others again 97° F., and so on until in one animal 107·6° F. was registered. This last case was particularly interesting in that this





Fig. 5. The Tarbagan. The long claws are well seen.



Fig. 6. The Tarbagan. Note the small ears and sharp lower incisors.







Fig. 7. The Tarbagan. Side view.  
Note the fierce appearance.



Fig. 8. A dead Tarbagan showing measurements.  
Tip of nose to tip of tail = 65 cm. = 25½ ins.  
,, ,, base ,, = 42 cm. = 16½ ins.  
Wt. = 10 E. lbs.





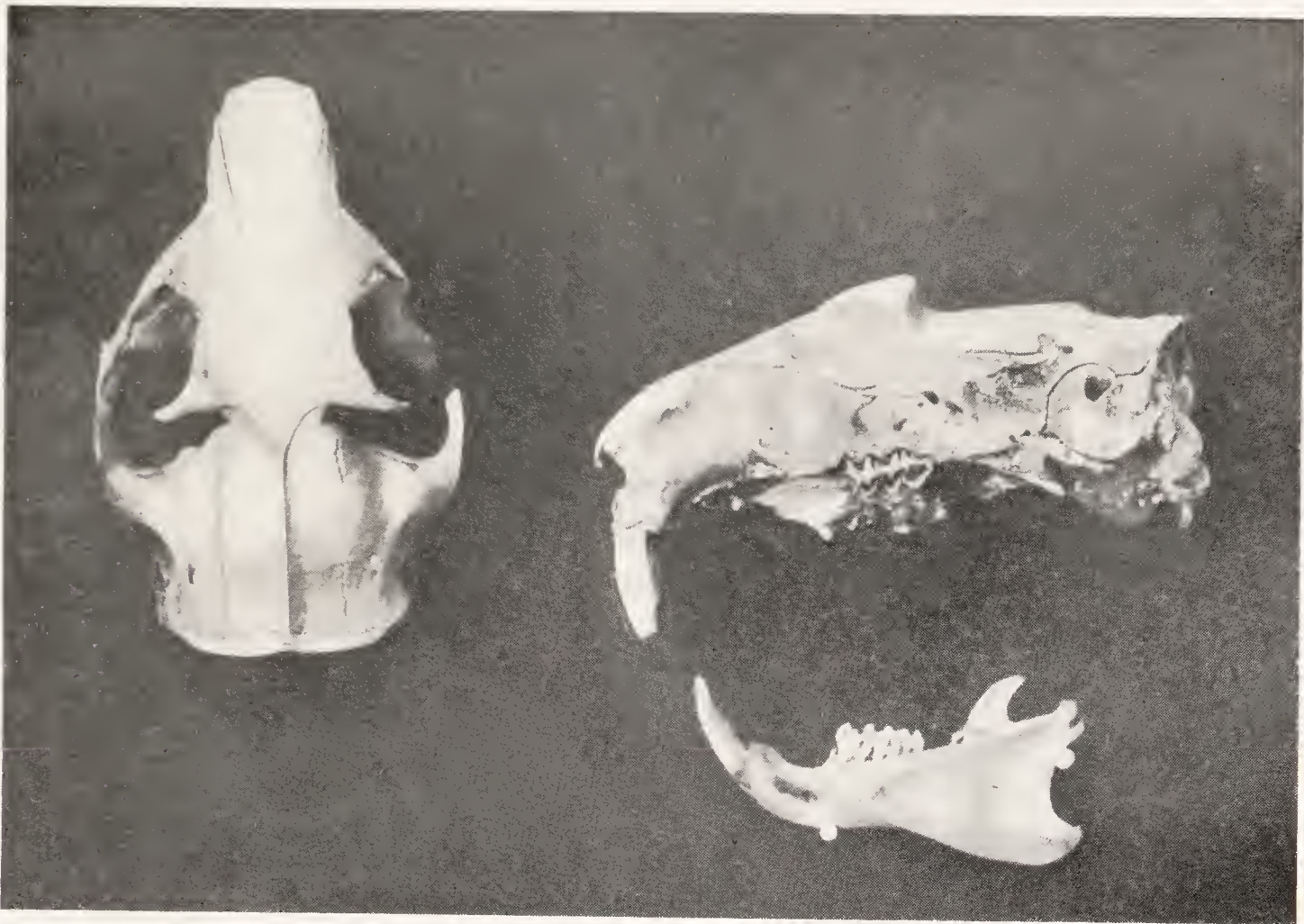


Fig. 9. Skull of Tarbagan as seen from above and laterally.



Fig. 10. The Tarbagan regions. Arabulak (Siberia).  
Note the mounds or "bootans" against the skyline.





temperature was obtained soon after capture. It died, however, 20 minutes after the temperature was taken and 61 minutes after capture. At the post-mortem nothing abnormal was found. In one of the animals the temperature varied from 98·5° F. to 104·8° F. within the space of three days.

*Distribution of the Marmot.*

The Marmot inhabits a wide range but is confined to the Northern hemisphere. In North America the common species is the Woodchuck, the distribution of which is from the Carolinas northward to Hudson's Bay, and westward from the Atlantic Coast to Missouri, Iowa, and Minnesota; but other species are met with in the Rocky Mountains and in the north-western parts of America, even as far as the Arctic Regions.

In the Old World, the best known species are the Bobac (*Arctomys bobac*, Schreb.) and the Alpine Marmot (*Arctomys marmota*). The region of the former extends from the south of Poland and Galicia over the steppes of Southern Russia and the bare regions of Siberia to Northern Mongolia, North-West Manchuria, the Amur Regions, and on to Kamstchatka, whilst it is found in elevated regions as far south as Cashmere, Thibet, and the Himalayas, but the southern limits have not been defined accurately. The Alpine Marmot is confined to the higher regions of the Alps, Pyrenees and the Carpathians. A small species—*Spermophilus citellus*, Linn.—is found in abundance in South Manchuria, especially around the neighbourhood of Mukden. This species bears little resemblance to *Arctomys bobac*.

*Habits of the Tarbagan.*

In the regions where the Tarbagan abounds, it can easily be seen either running about on its four legs or standing on its mound near the entrance to its burrow. It can be made out without difficulty in the distance as the immediate neighbourhood of the entrance to its burrow and part of the mound is devoid of grass, due no doubt to its constant presence there and to its having eaten away the grass. One or more animals may be seen resting on one mound, sometimes on all four limbs, but more often on the hind legs, the fore paws being raised with the palms turned forwards. They like the sunshine and seem to enjoy nature, uttering a noise, when at ease, similar to "pi ah, pi ah"; this has been likened to "pu p'a, pu p'a," which in Chinese means "no



Map of Tarbagan Region.

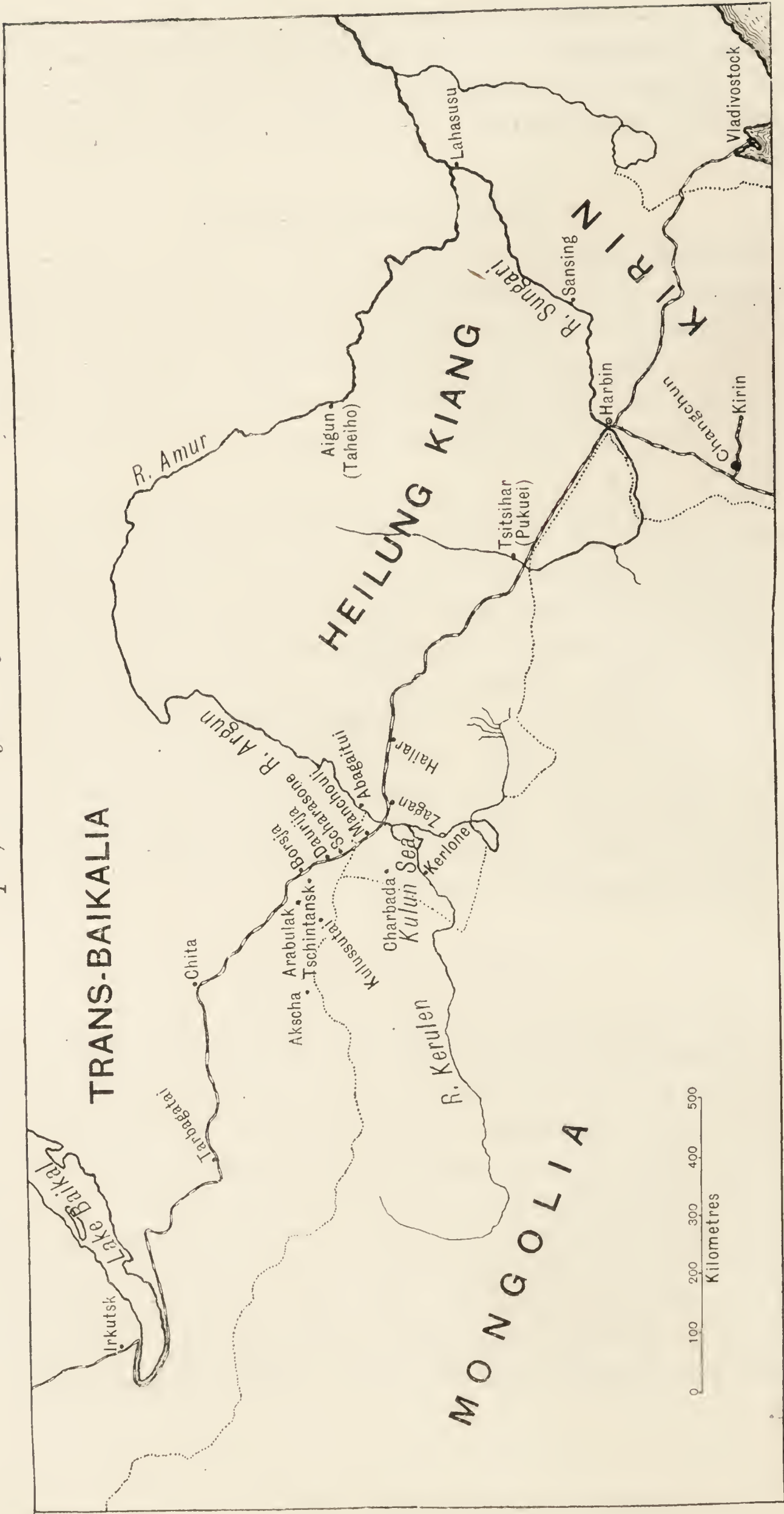






Fig. 11. The Tarbagan regions near Manchouli. Note the large mounds (against skyline) and the smaller ones in front.



Fig. 12. Entrance to a newly made Tarbagan burrow. Tschintansk (Siberia). Note the absence of grass around the burrow. The ground was level and sandy.









Fig. 13. Entrance to a Tarbagan burrow situated on the slope of the hill shown on Fig. 10. Arabulak. Note rocky nature of ground and faeces on the bare space to the left of burrow.



Fig. 14. Two entrances to an "Earth." Arabulak. Note the long grass on part overhanging the burrows.





harm, no harm." The ears are very sensitive to touch but hearing is not as acute as in hares, and hence they make more use of their eyes for the detection of any possible foe. On the approach of a stranger they let fall the front paws, and immediately retire into the burrows, to come out again as soon as they feel the danger is past. When running a considerable distance their action is like that of the rabbit. When frightened they utter a cry similar to a child's "eh eh!" The Tarbagan in captivity is a very fierce animal, using his front teeth freely and biting deeply those who come in his way. With his sharp claws he scratches effectively when carelessly handled. For dealing with those we had in cages, strong forceps of considerable length had to be made, each blade curved so as to give a firm grip on the neck or body (see Pl. X, fig. 19). When placed in a wooden cage lined with parallel bars of soft iron,  $\frac{1}{2}$  inch in diameter, the animal escaped in a very short time by bending the iron rods with his strong jaw and by biting the wood of the cage with his sharp teeth. An adult person was unable to bend such a rod.

#### *Habitat.*

The Tarbagan regions of North Manchuria and Siberia are well seen from the windows of the Trans-Siberian trains between Hailar and Manchouli, extending for a distance of 650 versts. The characteristic mounds are present everywhere, especially to the north of the line, and not uncommonly the animals are visible sitting outside the entrances to their burrows.

The holes are sometimes single, sometimes multiple, and on one mound as many as eleven have been counted by us. When occupied, the tops of the mounds are usually bare, whereas grass grows abundantly around the openings of deserted burrows. Hunters informed me that in winter when grass is absent, and the animals are hidden inside their burrows, they detect them by the peculiar smell given forth. I myself tried to detect the odour, and was satisfied that it was characteristic. The presence of innumerable mounds, or "bootans" as the Russians call them, is very distinctive of the Tarbagan country, where the land presents a series of undulations, over some of which the grass grows to an unusual length (Pls. V-IX, figs. 10-18). These mounds have been made from the earth thrown up by generations of Tarbagans in the course of their digging operations. Where the mountains are of rocky formation, as at Arabulak in Siberia, large pieces of stone, some weighing as much as two pounds, were seen lying at the entrance of the burrows; these



had evidently been dug up by the animals whilst making their burrows, and showed the great strength of their paws. In other parts, however, the land is more sandy in nature, and beyond their raised appearance they present no great variations. The entrance to the burrow is funnel-shaped, and ranges from  $1\frac{1}{4}$  to  $2\frac{1}{2}$  feet in diameter. At the entrance twigs and seeds are often found, probably the remains of food, and also hard faecal matter. The tunnels vary from  $\frac{1}{2}$  to  $1\frac{1}{4}$  feet in diameter becoming narrower as they are traced inwards. When two holes are, say, 12 feet apart, a straight connecting path may be seen where grass has not grown, thus showing that frequent communication takes place between the animals. From the entrance, a sloping passage 5 to  $6\frac{3}{4}$  feet (150 to 200 cm.) long leads to a horizontal, more or less zigzag tunnel, the depth of which is  $3\frac{3}{4}$  to  $5\frac{1}{2}$  feet (110 to 180 cm.) from the surface. Along this underground passage there are specially widened spaces, at some of which faecal matter is deposited, whilst at others there are stored dry grass and twigs—apparently the living quarters of the animal. Very often, when other entrances are traced, they are found to lead to a common passage, so that at places a series of subterranean tunnels extending for hundreds of yards may be said to exist. It is interesting to note that in the course of our digging operations the skulls and bones of Tarbagans were found in the passages, showing that in past times Tarbagans had died in their subterranean homes. Considering that the ground in North Manchuria and Mongolia is frozen in winter to over six feet deep, the Tarbagan may be said to pass through his long hibernating period well within the freezing zone, as the burrows seldom reach a depth of 5 feet. Some of these burrows end blindly after a distance of 4 feet (120 cm.), but others communicate freely. This was instanced by the fact that traps laid for days outside one opening did not catch any animal, and stones placed by us to block an entrance did not affect his peregrinations (Pls. VIII–IX, figs. 16–18).

Regarding breeding, there is reason to believe that the Tarbagan is not as prolific as the rabbit—two or three being the average number of young ones born each season. When the young are old enough to look after themselves, the mother leaves them in the old burrow and digs a new one for herself. Many half completed burrows were met with in the summer of 1911 during the course of our journey. The new burrows in some cases led to old “earths.”





Fig. 15. Tarbagan burrow opened. No. A. Aug. 19th, 1911. Near Manchouli.

In this burrow some old Tarbagan skeletons were found.

- 1 The hat indicates entrance 2. 2 indicates blind terminus. 3 indicates nest.  
4 indicates enlarged space containing faecal matter. 5 sloping entrance 1.



Fig. 16. Tarbagan burrow opened. No. B. Aug. 19th, 1911. Near Manchouli.

- 1 blind end. 2 indicates burrow going upwards. 3 enlarged space in which lies the nest, indicated by handkerchief. 4 the hat indicates sloping entrance.









Fig. 17. Tarbagan burrow No. B traced further. Aug. 21st, 1911.  
Note its great depth.



Fig. 18. Tarbagan burrow opened in March, 1911 (winter), partially filled up.





*Hibernation.*

The Tarbagan hibernates from October to April; at the end of September 1911 the weather was becoming cold at Manchouli and Dr Ch'en noticed that some of the animals in the cages began to curl up preparatory to hibernation. In winter the cold is very severe, the thermometer marking  $-30^{\circ}$  to  $-40^{\circ}$  C. Indeed, Marmots seem to be the most thoroughly hibernating of all mammals, since their sleep is apparently unbroken, and they lay up only a small store of winter food, consisting of grass, roots and the seeds of plants. Whilst in this stage they are utterly helpless. In March, 1911, before the cold season had passed away, twenty-four Tarbagans were dug out from their several burrows in the neighbourhood of Manchouli. They were found lying in the nests of soft herbage far away from the openings of the burrows. For some time, however, after their retirement they continue active within their domicile and feed upon the food which they have gathered during the summer; and as a preparation for their winter sleep, they become exceedingly fat during the autumn. With the return of spring comes renewed activity on the part of the animals, and they venture into the open. Hence the hunters choose the months of April, May and June for hunting them. July and August is the breeding season, and the Chinese authorities forbid trapping during these months. After August they are again hunted until the approach of cold weather—about the end of September.

*Method of catching the Tarbagan.*

The method generally adopted by the Cossack and Chinese hunters for catching Tarbagans is simple in the extreme. A piece of medium-sized iron wire,  $2\frac{1}{2}$  feet in length, has one end twisted in the form of a running loop, whilst the other end is wound firmly round a rough wooden peg  $\frac{3}{4}$  foot long (Pl. X, fig. 19). The peg is driven into the ground immediately above or on the side of the entrance to the burrow, and the loop is arranged so that it fits exactly into the opening. When the animal comes out, the head and probably also one of the front paws are caught in the loop. The more it struggles the tighter the snare becomes, and in this state the hunter finds the animal when he returns from his rounds. Sometimes, double loops are attached to a single peg in order to obtain a more secure hold of the animal. The cost of the complete snare is only two copper cents (about one half-penny). In our



own experience the snare proved to be the most successful means of catching the Tarbagan. The hunters informed me that on lucky days they could catch from five to six animals, which meant an earning of 4–5 roubles a day (counting the price of each skin at 80 kopecks).

*Method of killing and skinning.*

After capture, the animal is killed by a method called “breaking the neck.” The animal is seized by the hind legs, a stick or bar of wood is placed on the back of the neck with one foot at either end of the stick, and then the animal is pulled backwards and upwards. This quickly dispatches the creature, and saves the fur from being soiled with blood. From enquiries made it appears that skinning is not done on the spot, but only when the hunters have gathered again in their common camp—frequently after two or three days’ absence. Skinning is performed by incising the two corners of the mouth, separating the skin from the soft parts of the jaws and then pulling the complete skin from before backwards and from within outwards, *i.e.* the skin is turned inside out. As previously noted, when travelling in Mongolia, isolated heaps of Tarbagan bones were often seen—evidently the remains of carcasses left after the animals had been skinned. The raw skins or “pelts” are dried, collected together, and put aside until the end of the hunting season, when they are brought by the hunters to the markets of Borsja (Siberia), Manchouli, and Hailar<sup>1</sup> (North-West Manchuria), and sold to dealers—usually Russian Jews.

*The Tarbagan in commerce.*

The trade in fur has been fully dealt with already (see pp. 23, 24). Besides using the fur, the Siberian settlers and Mongols eat the flesh of the Tarbagan (see p. 31). When at Charbada the members of our party partook of the flesh and found it tender and the taste distinctly good, comparing favourably with the flesh of the rabbit. Considerable quantities of the flesh are salted and exported to European Russia.

In addition, the fat, which is plentiful under the skin of the animal, is turned into a valuable kind of grease much used by Russian peasants for preserving leather; they also apply it for the healing of bruises.

<sup>1</sup> Borsja is 121 versts west of Manchouli. Hailar is 174 versts east of Manchouli.





Fig. 19. On the left is a single snare with wooden peg. On the right is a strong trap (rarely used). In the middle, the special forceps.



Fig. 20. Tarbagan cages. Manchouli. Aug. 14th–Sept. 30th, 1911.  
Note various types.





*The Tarbagan in captivity.*

*Cages* (Pl. X, fig. 20). For keeping the animals we used both single and double cages made of thin iron plates. These had doors in front and behind so as to facilitate cleaning and the transference of the animals from one place to another. The sides were perforated with a few round holes for ventilation. Rods and parallel slits were found impracticable, as the animals easily damaged them and sometimes escaped. For experimental purposes single cages were made with a glass front to allow of observation.

We originally took with us from Harbin a few cages made of wood, one inch thick, and provided in front with soft iron bars half-inch in diameter; but the animals quickly destroyed these, gnawing away the wood and bending the bars.

In Mongolia and Manchouli it was found, as indicated elsewhere in this Report (Appendix I, pp. 50, 51), that Tarbagans often died when kept in close captivity. In March 1913, *i.e.* the end of winter, 13 animals were dug up while still hibernating and placed in cages. Within ten days two had died and before five weeks had passed, four more succumbed. Two Tarbagans presented in 1911 to the Zoological Gardens in Peking were kept on earth in a spacious pen; after a year they were still alive and healthy. We propose therefore to adopt a similar plan for keeping these animals in future.

For food, hay, cabbage, carrots, and ground nuts have been found satisfactory; a pan of water in the cage does not seem necessary.

*Forceps for handling the Tarbagan.*

It was some time before we found the most convenient and suitable type of forceps to use in handling Tarbagans. The pair of forceps eventually employed (Pl. X, fig. 19) is made of stout wrought iron, 20 to 22 inches long, and thickest at the handle. The blades used at the end for gripping the animal are curved to form an oval ( $4\frac{1}{2}'' \times 3\frac{1}{4}''$ )—this being large enough to take hold of the neck or body without injury. Distal to the oval the blades are prolonged parallel to each other for a distance of half-inch and are there rounded off.

*Parasites of the Tarbagan.*

In its natural state the Tarbagan harbours two kinds of blood-sucking arthropods, namely the flea and the tick. The fleas were more numerous on the animal when freshly caught than after it had been in captivity



for some time. Most of the fleas were caught in the groins, but often they were distributed over the whole body. The ticks were usually attached to the eyelids, but on one occasion we found two ticks on the abdomen and none on the eyelids. The number of fleas per animal varied greatly even just after capture. For example, we caught 94 fleas on a Tarbagan at Charbada; the fleas on Tarbagan No. XVIII (see page 51) were noted as numerous; on Tarbagan XXIII, three days after capture, no fleas were found but only four small ticks and one large tick; on Tarbagan XXVIII (see page 51) two fleas and two ticks were found. All the fleas were of the same species, namely *Ceratophyllus silantievi*, Wagner 1898. I append a short description taken from those we collected.

#### *Fleas.*

*Ceratophyllus silantievi* (Pl. XI, fig. 22). An eyed, single-combed flea of large size. Of six males, the shortest was 1.97 mm. long, the longest 2.34 mm., whilst the average length was 2.2 mm.; of 13 females the shortest was 1.48 mm., the longest 3.07 mm., whilst the average length was 2.82 mm. The eye is small and the antennae are well developed; the base of the antenna is situated at some distance directly above the eye, and the antenna when lying in the groove is directed downwards and backwards. There are three bristles, one in front of the other, anterior to the eye. The maxillary palps and mouth parts (epi-pharynx, mandible, labium) are long and well developed. Springing from the posterior border of the first thoracic segment is a comb consisting of nine bristles on either side. The mesosternite has a vertical thickening (bar). The inner aspect of the femur is studded with numerous hairs. The posterior border of the hind tibia presents six pairs of bristles. The last joint of the tarsus has six bristles on either side and the claws are fairly long. There are nine bristles inserted on either side near the posterior border of the tergal plates. The antepygideal bristles are three in number on each side.

#### *Biting experiments with Fleas and Ticks obtained from the Tarbagans.*

The insects were removed from the Tarbagans directly the animals were caught and were placed in test tubes.

The following experiments were carried out by us when in Mongolia and later on our return to Manchouli. As will be readily understood, the conditions did not permit of detailed and prolonged experimentation



Fig. 21. Taking rectal temperature of Tarbagan. Manchouli.



Fig. 22. *Ceratophyllus silantievi* Wagner. The Tarbagan flea.





and this record is given merely as a preliminary communication on the subject.

*Experiment 1.* When at Charbada, some six fleas in a test tube, immediately after their removal from the Tarbagan, were given the opportunity of biting one of us. Even after several minutes none of them had bitten.

*Experiment 2.* August 10th, 1911. *Ceratophyllus silantievi*, 1 ♂. Starved for three days. Then given facilities for biting the arm of one of the party. The insect moved about for some minutes before biting. It chose a spot in a fissure of the skin and plunged its proboscis deep in. While sucking its body was tilted upwards and the insect was seen to increase in bulk. It remained thus for eight minutes and then, having withdrawn the proboscis, fell on its side. Afterwards it began moving around less actively than before.

The person bitten experienced no pain and very little sensation both when the flea pierced the skin and during the time the insect was sucking. After the flea had withdrawn its proboscis, the site of the puncture was barely visible to the naked eye and with the aid of a hand lens a very slight escape of blood was seen to have taken place from the puncture. There was no after swelling or irritation.

*Experiment 3.* August 14th, 1911. *Ceratophyllus silantievi*, 1 ♂, 1 ♀, having being starved for some days, were placed on the arm of the police sergeant. Both behaved in a similar manner to the flea used in Experiment 2. After sucking for 10 minutes and before they had withdrawn their proboscides, the experiment was accidentally disturbed and the fleas fell to the ground. In this case also no after irritation occurred.

*Experiment 4.* August 14th, 1911. *Ceratophyllus silantievi*, 1 ♂, having been starved for four days, was allowed to bite the arm of one of the servants. The insect moved around for about five minutes and then, choosing a fissure of the skin, inserted its proboscis. At first the body of the flea remained in the horizontal position while the distal portion of the proboscis was inserted. Gradually the proboscis was buried completely and by that time the flea's body had assumed the more or less vertical position. As in the preceding experiments, there was an almost complete absence of after-effects.

The Ticks (a species of *Rhipicephalus*<sup>1</sup>) were collected in test tubes and similar experiments to those with the fleas were carried out. In no case did a tick bite the arm of a human being, although the tick used in one experiment had been starved for eight days.

<sup>1</sup> ? *R. haemaphysaloides*, nymphs.



## IX. SUSCEPTIBILITY OF THE TARBAGAN TO ANTHRAX.

Anthrax is a disease very common in Siberia where it attacks both human beings and horses, it being known in the latter as the "Siberian Pestilence." After our return to Manchouli on August 14th we determined to find out whether the Tarbagan was susceptible to this disease as no experiment of the kind had been performed before.

*Experiment I. Tarbagan XIV.* On the evening of August 20th, 10 c.c. of a 24 hours' old bouillon culture of *Bacillus anthracis* were inoculated into the loose subcutaneous tissue of the back of a healthy adult Tarbagan. The animal became very ill, and on the morning of August 23rd was found curled up and lying on its side dead.

The temperature recorded was as follows:—

August 18th,	E.	98.6° F.
19th,	E.	101.7 „
20th,	M.	99.8 „
	E.	98.4 „

10 c.c. bouillon culture of *B. anthracis* injected.

21st,	M.	100.4° F.
	E.	102.2 „
22nd,	M.	100.8 „
	E.	—

*Post-mortem Findings.*

Slight swelling and marked induration around the point of inoculation. Superficial veins dilated. General venous engorgement. No petechial haemorrhages.

Lungs: very slight congestion.

Heart: coronary vessels dilated; right side of heart dilated.

Liver: enlarged and congested.

Spleen: markedly enlarged and congested.

Microscopically: *Bacillus anthracis* found in the heart blood, blood from superficial veins, peritoneal fluid, pericardial fluid, scrapings from the spleen and liver. No particular variation in the distribution of the bacilli was found. The organism was obtained in pure culture from the heart's blood.

*Experiment II. Tarbagan XVII.* On the evening of August 20th, 5 c.c. of a 24 hours' old bouillon culture of *Bacillus anthracis* was inoculated into the loose subcutaneous tissue of the back of a healthy adult Tarbagan. The animal became very ill and on the morning of August 23rd was found curled up and lying on its side dead.

The following is the temperature recorded:—

August 19th,	E.	98·2° F.
20th,	M.	96·8 „
	E.	98·2 „

5 c.c. bouillon culture of *B. anthracis* injected.

21st,	M.	100·8° F.
	E.	103·4 „
22nd,	M.	100 „
	E.	—

#### *Post-mortem Findings.*

Marked swelling and induration around the point of inoculation. Glands in neck and axilla a little enlarged and showing petechial haemorrhages: femoral glands markedly enlarged. Other appearances, the same as in Tarbagan XIV, Experiment I.

These two experiments prove, therefore, that the Tarbagan is susceptible to Anthrax and the post-mortem findings are similar to those seen in other susceptible rodents.

### X. INVESTIGATIONS INTO REPORTED OUTBREAKS OF PLAGUE AT PUK'UEI.

When at Manchouli, it was reported in the local papers that several fatal cases of Plague had occurred at Puk'uei (Tsitsihar) in the quarter allotted to the *maisons publiques*. These reports gave apparently substantial details regarding such symptoms as headache, fever, coughing of blood, etc.—all pointing to an outbreak of pneumonic plague. I determined to visit Puk'uei without delay to enquire into the matter. I arrived there on August 26th. On investigation I found that two or three servants attached to the houses had recently suffered and died from *acute enteritis*, which could be traced to the raw fruit and iced drinks of which they had partaken freely during the prevailing hot weather. There was nothing to indicate an epidemic, and having satisfied myself fully as to these points, I left for Harbin on August 28.

It may be added here that reports of a similar kind had been circulated in Changchun, Dalny and other places. All these on investigation proved groundless.

Simultaneously with the report of Plague in Puk'uei, there came news that four deaths from bubonic plague had occurred among Russians



at Scharasone; these cases were confirmed later on, as well as a fifth case occurring in the same village<sup>1</sup>.

*Susceptibility of the Tarbagan to Bacillus pestis.*

When at Manchouli, August 14th to 25th, we proposed performing some experiments on the susceptibility of the Tarbagan to Plague. Unfortunately our cultures of *Bacillus pestis* proved to be of an avirulent strain. Owing to difficulty of transit we were unable to obtain other strains. Hence the experiments could not be carried out.

That the Tarbagan is susceptible to *Bacillus pestis* has been shown by Strong and Teague, Zabolotny, Dujardin, Beaumetz and Mosny.

XI. EVIDENCE ASSOCIATING THE TARBAGAN WITH PLAGUE AND CONCLUSIONS THEREFROM.

The Tarbagan has been said to suffer from a chronic form of plague not unlike the form seen in rats. From time to time epidemics have been reported as occurring among the Tarbagans causing them to die in thousands. It has been said that hunters easily recognise the sick animals—these often being driven out from their holes to wander about aimlessly until they die. The piteous state of these animals has been graphically described.

If a human being takes plague and has eaten of the flesh of the Tarbagan—a very common food among the Mongols and Cossacks (page 31)—it has been stated forthwith that this is the source of infection. Indeed, whenever a case of human plague occurs in a remote district of the Tarbagan country, it is stated almost invariably that the disease has resulted from the eating of Tarbagan flesh. Take the following excerpt, translated from a paper issued on December 8th, 1912, as an example:—

“News has come from a village Onon-Borzinski, near Chita, to the effect that some Cossacks, three in number, had been stricken with plague and died. It appears that they had returned at the beginning of October (old style) from Zagan-Olnevski where they had been hunting Tarbagans and had brought with them some frozen Tarbagan flesh. On October 31st one of these Cossacks took ill with symptoms of fever and spitting of blood and died after two or three days’ illness. The others followed.”

Comment is needless!

<sup>1</sup> Scharasone is the Russian village 30 miles west of Manchouli where Dr Issaief picked up his Plague Tarbagan in June, 1911 (see p. 26).

Some of the epidemics referred to as occurring among the inhabitants of the Kirghiz settlements (pp. 15—19) were said to have been associated with a disease in camels, and one case of human plague was said to have followed the consumption by the patient of the flesh of a camel stricken with plague.

To quote further examples would be useless and to mention individual authors invidious.

It is my purpose to review the facts which have so far been ascertained bearing upon the relationship of the Tarbagan to the outbreak of plague in human beings. It need scarcely be said that before a diagnosis of plague is established a complete bacteriological examination must be made. It has been definitely established that rats suffer from plague and from them the disease is conveyed to man. The chronic form of plague has been found among the gophers and ground-squirrels (*Citellus beecheyi*) of the Western United States by McCoy. Mice and guinea-pigs are susceptible to artificial infection with *Bacillus pestis*. Strong and Teague, Zabolotny, Dujardin, Beaumetz, and Mosny have shown that the Tarbagan also is susceptible, and Shibayama has demonstrated that *Spermophilus citellus*, the small species of marmot common about Mukden (page 33), is susceptible to plague though not so susceptible as the rat.

Since these Rodents are susceptible to plague and since the disease occurs in nature among rats and ground-squirrels, *a priori* it is conceivable that it occurs among Tarbagans in nature.

Let us examine the evidence available to establish this as a fact. An epidemic among the Tarbagans was reported in July 1911 (page 12), and the Russian and Chinese expeditions at once visited the country where this epidemic was supposed to exist. Not only did the expeditions fail to discover a single diseased Tarbagan, but enquiries made by us directly from the hunters showed that they knew nothing of the alleged epidemic. In the experience of these hunters not only had no epidemic ever occurred among the Tarbagans but they had never even seen sick ones. In Mongolia, the Chinese expedition had similar results nor could any news be obtained of disease, past or present, from the Mongol hunters. In passing, I would emphasise that information was sought by us direct from hunters who were experienced men and who had spent their lives living and hunting in the country where the Tarbagan abounds. Moreover two of the police who accompanied us on our Mongolian expedition were formerly Tarbagan hunters; and the Finn hunter whom we took with us had been hunting regularly for the past five years and could recall no case of Tarbagan disease.



Dr Ch'uan, in his paper at the International Plague Conference, already referred to, stated: "I had several talks with the marmot hunters and enquired whether they knew of the occurrence of any cases of sickness, such as blood spitting or of sudden death during their hunting season on the hills. They replied that they had never known of such cases either on the hills or on their return journey, and that only at Dawoolya, Manchouli or other towns did the plague attack the marmot hunters and others." The enquiries we made on this point from the hunters elicited the same information. We did not hear of any case of plague having occurred amongst them while on the plains. It is well to state here that although the Tarbagan hunters dispersed in pursuit of their business, staying away for one or several weeks, they usually reassembled at the regular camps to skin the animals captured. Moreover, although millions of Tarbagan skins were exported yearly to Europe, and thus handled by hundreds, perhaps thousands of people, from the hunter and the railway porter to the factory labourer, no case had ever been reported of plague infection in human beings during the transit of such skins. It is also very doubtful whether plague occurs as a result of eating plague infected flesh. As bearing upon this question the following may be quoted:—"In many instances during the Manchurian epidemic the patient with pneumonic plague must have swallowed enormous numbers of plague bacilli in the saliva and sputum. Nevertheless, in none of the necropsies performed during the epidemic were evidences of primary intestinal infection present, nor was serious involvement of the intestine encountered. This fact certainly speaks strongly against the evidence of primary intestinal plague in man and would seem to show that even if the intestines are sometimes secondarily involved, this condition in human beings must be also a very rare one." (Strong and Teague.)

Moreover, referring to the disease in camels mentioned above, Mr Shuropof, a veterinary surgeon who investigated the possibility of this animal suffering from plague, concluded that the camel was entirely insusceptible to the disease. He thinks that the observations made in the Kirghiz steppes must be received with doubt and that possibly the organism isolated from the dead camel was the *Bacillus bipolaris plurisepticus*, and not the plague bacillus (*Vratch*, No. 52, December 31st, 1911, quoted in *Lancet*, March 9th, 1912, page 688).

The only definite proof that Tarbagans in nature are affected with plague is obtained from the animal caught by Issaief in June at Scharasone, and examined by Zabolotny (pp. 25, 26).

To conclude that a man whose occupation is that of a Tarbagan hunter and who takes plague has been infected from a Tarbagan is comparable to concluding that a man who sells rice and who develops plague has been infected from the rice. In the latter case it is possible that the rice through the rat flea was the source of infection; but if, without some proof that this were so, the statement was made, such a conclusion would be at once condemned as unjustifiable. From the above it seems to me a pity that responsible authorities and medical men should be so obsessed with the unestablished idea of the great infectivity of the Tarbagan as to place hindrance in the way of transporting by rail live healthy Tarbagans for important scientific research at our headquarters laboratory at Harbin, an experience which I had in March of this year.

### *Conclusions.*

1. Even though the Tarbagan occasionally suffers from Plague, the epizootic is never extensive, and the animal does not play nearly so important a *rôle* in the spread of Plague as does the Rat. Indeed its direct relationship to human plague may be considered negligible. Moreover, the mode of living and habits of the Tarbagan are very different from those of the Rat: for example, while the Rat is a more or less domestic creature in close contact with man, the Tarbagan is the reverse.

2. From the writings of Russian authorities, it appears that Plague has existed for many years in various parts of Siberia, sometimes in the bubonic form, sometimes in the pneumonic form. These places may be looked upon as endemic foci. In 1910 it is believed that pneumonic Plague appeared in the Russian Ural District long before it made its appearance at Manchouli and developed into that great Manchurian epidemic. During the latter half of 1911 this form of Plague was present in the Kirghiz settlements. In these districts, from October 1911 to February 1912, over 200 cases of Plague occurred. No case of Plague, in man or animal, has occurred in Manchuria since the epidemic of 1911.

3. From this report it is obvious that statements of the occurrence of Plague among men or animals should be believed only when they come from responsible sources—that is, after proper medical and scientific investigations.



## XII. RECOMMENDATIONS REGARDING TARBAGAN FUR TRADE.

Writing from Manchouli Station on August 21st, 1911, the following were some of the recommendations I made to the Chinese Government in regard to the Tarbagan Fur Trade:

"1. That as far as this year is concerned, the Order (prohibiting the hunting of Tarbagans) should stand so as to allow the animals a chance of breeding. In a large part of the territory within 100 *li* of Manchouli, the animals were practically exterminated last year, some 2,000,000 having been killed.

"2. That two central stations, say Manchouli and Hailar, should be established, with a medical staff at each place. To these stations the skins should be sent for inspection and disinfection (if necessary). After examination and disinfection (if necessary) a chop<sup>1</sup> should be imprinted on each skin, certifying its healthy state and allowing it to be exported.

"3. That the usual tax of roubles 6.80, should be levied on every hunter for each season. Last year (1910) two seasons were permitted, but I would suggest only one season be permitted in future so as to preserve the animals from extinction.

"4. That whenever permits are issued to the hunters, directions (verbal as well as written) should be given for protection against possible infection, such as keeping the raw skins away from their sleeping quarters and supervising, if not establishing, lodging houses where the hunters may lead a hygienic life."

I further stated:

"In carrying out these recommendations, doubtless a few difficulties would be encountered, but I am sure the best method is to control in a rational manner the Tarbagan trade rather than to abolish it entirely. A very small percentage indeed of Tarbagans catch the disease, and supervision would be quite an easy task.

"The following are some of the advantages of effective control:

"1. The poor people will be profitably occupied and a large and increasing business will be saved from destruction.

"2. Good scientific work will be done by the doctors and hence our knowledge of Plague and of Tarbagan diseases will be increased."

<sup>1</sup> Government mark or stamp.

### XIII. OUTBREAK OF PLAGUE ON S.S. *CHEONGSHING*.

At the beginning of June 1912, I received instructions to enquire into some deaths from Plague which were reported to have occurred in Tientsin. I ascertained the facts to be as follows:

The S.S. *Cheongshing* arrived at Tientsin direct from Hongkong on the evening of May 31st, 1912.

The first purser's wife, aet. 30, died on board on May 29th, while the boat was at sea.

On June 2nd the first purser, aet. 43, complained of shortness of breath and faintness. He was diagnosed as suffering from pneumonia, and was admitted on June 3rd to a mission hospital in Tientsin; the patient died a few hours after admission. On June 4th the second purser, aet. 36, complained of tightness of the chest and cough with blood-stained sputum. He was admitted to a Government hospital with the diagnosis of pneumonia. He died early next day (June 5th). Lung puncture, performed after the death of the patient, revealed *Bacillus pestis*—this being confirmed afterwards by complete bacteriological examination.

The Port Health Officer did not diagnose and hence did not certify plague, and allowed the steamer to leave Tientsin on June 5th bound for Chefoo. Off Chefoo the vessel was quarantined on account of a wire from the Chinese authorities and was not permitted to approach the town. On June 8th the vessel sailed for Shanghai.

At Woosung, ten miles from Shanghai, the vessel flew distress signals as more cases of plague had occurred; one fireman and one seaman had died on June 14th. The vessel was quarantined and the crew and passengers were isolated. No further cases occurred and the steamer reached Hongkong in safety.

Later I ascertained that the female patient had lived in a house in Hongkong where two deaths from plague had occurred just before coming on board.

In connection with these cases of pneumonic plague it is interesting to observe that the wife of the first purser was supposed to be suffering from pulmonary tuberculosis. To ease the cough the second purser lent the patient his opium pipe to smoke, afterwards using it himself. In all probability the husband of the patient smoked from the same pipe, as in such cases it is customary for another person to prepare it for use.



Whether the pipe was the direct means of conveying the infection is problematical as the trio had been in close communication in using the small ship's cabin: it is certain that the usual spread of pneumonic plague is by the direct inhalation of the micro-organism.

## APPENDIX I.

### *Rectal Temperature of the Tarbagan.*

The series of temperatures given in the accompanying table were taken at Manchouli after our return from Mongolia.

The animals were kept in cages. An animal was removed from the cage by means of the special forceps and was held resting on the ground by one of us while the other took the temperature (see Pl. XI, fig. 21). The morning temperature was taken about 9 a.m. and the evening temperature between 3 and 5 p.m.

Often after capture by the snare the animal died, no obvious cause being found at post-mortem examination. A larger percentage of those caught with double snares died than those caught with single snares.

## PROTOCOL.

*Tarbagan No. XI.* Healthy during the whole time the observations were taken.

*Tarbagan No. XII.* September 9th. Appeared sick, lying quite still and apathetic; does not resent provocation; all limbs paralysed, unable to move when placed on back; no crying; no convulsions. Death. *Post-mortem*: some of the glands in neck congested but not enlarged; spleen enlarged but not congested; liver shows fatty degeneration; gall bladder distended with gas, no bile, adherent under surface of liver; small infarcts in upper lobe of right lung; pericardial sac contains more fluid than normal. Films made from the blood and organs show no micro-organism; no growth obtained in media inoculated with heart blood or from spleen.

*Tarbagan No. XIII.* August 22nd. Appeared ill in the afternoon. Hind limbs paralysed. Died early on August 23rd. *Post-mortem*: all organs normal. Films and cultures negative.

*Tarbagan No. XV.* September 9th. Paralysis of hind legs; resents provocation; utters no cries when brought out of cage; attempts to escape using fore legs only, hind legs being dragged. September 11th. Appears rather better, hind limbs still paralysed. September 13th. Cries when handled. September 18th. *In statu quo*.

*Tarbagan No. XVI.* Died suddenly on night of September 13th. *Post-mortem* showed cause of death to be a large rupture in the left lobe of the liver. Examination for micro-organisms negative (films only).

*Tarbagan No. XVIII.* Caught morning of August 19th. Attempted to escape while being brought to camp in sack. 3 p.m. Convulsions while lying on ventral surface ; appeared to be biting at cage in attempt to escape. 4.10 p.m. Quite apathetic ; temperature 107.6 ; had convulsions while temperature was being taken ; numerous fleas. 4.30 p.m. Gave a few gasps and died. Weight 10 lbs. (English). Length, tip of nose to tip of tail,  $25\frac{1}{2}$  inches ( $64\frac{3}{4}$  cms.). *Post-mortem*: nothing abnormal found.

*Tarbagan No. XIX.* Young animal. August 23rd killed and cooked.

*Tarbagan No. XX.* Healthy during the whole time the observations were taken. Killed for anatomical observations September 4th. Weight 9 lbs. Length, tip of nose to tip of tail,  $24\frac{1}{2}$  inches.

*Tarbagan No. XXI.* Healthy during the whole time the observations were taken.

*Tarbagan No. XXII.* Healthy up to August 27th when it showed symptoms similar to those noted above for Tarbagan XII and Tarbagan XV. Died in the afternoon. *Post-mortem*: organs showed similar appearances to those noted under Tarbagan XII. Smears made from the glands and organs showed bacilli which, however, were obviously not *Bacillus pestis* ; no growth in media even after six days.

*Tarbagan No. XXIII.* On August 28th died suddenly without previously showing any signs of illness. *Post-mortem* findings similar to those of Tarbagans XII, XV, XXII. Smears similar to those from Tarbagan XXII. No growth on media even after four days.

*Tarbagan No. XXIV.* Healthy during the whole time the observations were taken.

*Tarbagan No. XXV.* Healthy during the whole time the observations were taken.

*Tarbagan No. XXVI.* Healthy during the whole time the observations were taken. On September 30th the animal curled up through cold.

*Tarbagan No. XXVII.* In good health up to September 7th, then did not appear to want to feed. Died on September 18th. Very emaciated. *Post-mortem* examination revealed a small rupture in the right lobe of the liver ; adherent blood clot was present in the neighbourhood. Other organs apparently normal. Bacteriological examination negative.

*Note.* An animal (Tarbagan No. XXVIII) caught on August 25th died soon after being brought into camp. There were marks of severe constriction by the wires of the double snare around the neck and at the level of the umbilicus. *Post-mortem* examination showed no abnormal appearances.



Rectal Temperature in degrees Fahrenheit of 17 Tarbagans.

Aug. 18th—Sept. 13th, 1911.

	Tarbagan No. :—XI	XII	XIII	XV	XVI	XVIII	XIX	XX	XXI	XXII	XXIII	XXIV	XXV	XXVI	XXVII	XIV	XVII
Aug. 18	M. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	E. ...	...	100.8	...	...	...	...	...	...	...	...	...	...	...	...	98.6	...
19	M. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	E. 95	...	104.8	100.2	100.2	...	...	...	...	...	...	...	...	...	...	101.7	98.2
20	M. 99	99.2	100.2	100	97.8	...	98.4	...	...	...	...	...	...	...	...	99.8	96.8
	E. 99.8	98.6	101	97.8	97.8	107.6	100.4	...	...	...	...	...	...	...	...	98.4	98.2
21	M. 98.7	97.8	100.2	100	98.6	D	96.6	...	...	...	...	...	...	...	...	100.4a	100.8a
	E. 99	97	98.5	98.8	97.8	...	103.6	...	...	...	...	...	...	...	...	102.2	103.4
22	M. 96.4	97.6	95.2	99	96.4	...	K	99.6	102.8	...	...	...	...	...	...	100.8	100
	E. ...	...	D	...	...	...	...	...	...	...	...	...	...	...	...	...	...
23	M. 99.8	98.6	...	99	97.2	...	...	95	98.8	...	...	...	...	...	...	D	D
	E. 97.6	98	...	98.6	102*	...	...	98.4	99.8	99.4	...	...	...	...	...	...	...
24	M. 96.4	98	...	97	96	...	...	96.2	99	97.6	99.4	...	...	...	...	...	...
	E. 99	99	...	98.4	97.5	...	...	100	100.1	100.1	100.1	...	...	...	...	...	...
25	M. 97	97.5	...	98	95.2	...	...	95.2	96	98.8	101.6	98.6	...	...	...	...	...
	E. 100.2	100.1	...	100.6	97.8	...	...	100.6	96.4	100.2	100.4	97.4	98	...	...	...	...
26	M. 97.2	97.6	...	99.1	100	...	...	95.2	97.2	100.6	100.8	99.2	96.8	99.8	98.8	...	...
	E. 100	101.4	...	99.9	99	...	...	100	99	104	102.2	99	100.1	102.2	100	...	...
27	M. 99	99.6	...	100	99.2	...	...	97.4	100	95	100.4	98	96	98.6	102	...	...
	E. 99	99	...	99.6	99.4	...	...	97.2	98.2	...	102.6	97.2	96.8	99.6	98.4	...	...
28	M. 96.8	98.6	...	102.2	96.4	...	...	96.4	96.4	D	100.2	99	95.4	97.6	97.7	...	...
	E. 97	98	...	100	99	...	...	97.6	96	...	100.8	97.6	97	97.6	99.8	...	...
29	M. 97.6	99.4	...	99.4	98.8	...	...	98	99.2	...	95.2	100.6	97	97	98.8	...	...
	E. 101.1	100.1	...	100	98	...	...	98.4	97.6	...	...	99.4	97.2	99.2	100.1	...	...
30	M. 99.6	100.1	...	98.8	96.8	...	...	99	98.2	...	D	99.2	98.2	98.8	99.8	...	...
	E. 97.2	102.4	...	99	99.4	...	...	101	97.8	...	...	99.4	99.4	102.8	98.6	...	...
31	M. 97.4	99.2	...	99.2	98.4	...	...	97.4	97.4	...	...	99.8	97.2	98	97.4	...	...
	E. 98.2	99	...	98	98	...	...	96.8	99.2	...	...	101	97.8	101	99.4	...	...
Sept. 1	M. 99	99	...	99.8	99	...	...	97.2	98.4	...	...	100.1	97.4	98	98.2	...	...
	E. 95.7	95.7	...	97.7	97	...	...	99	99	...	...	101.7	101	101	99.2	...	...

2	M.	98.2	99.2	...	98.8	...	98.8	...	99.4	98.8	98.8	98.6	...	...
3	E.	99	97	...	97.6	...	97.8	...	99.8	99	98.4	97.4	...	...
	M.	97.6	98.6	...	99	...	99	...	99	98.4	98.4	99	...	...
4	E.	99	98	...	100	...	...	...	99	...	99	99.2	...	...
	M.	96.8	98	...	99.4	...	97.8	...	100.2	99.4	99.4	98	...	...
5	E.	102	...	...	99.6	...	...	...	99.8	...	99	99.2	...	...
	M.	100	100	...	98	...	98.6	...	98.4	98.8	98.6	98.6	...	...
6	E.	99.2	99.2	...	98.6	...	97.8	...	98	...	...	99.2	...	...
	M.	99.8	97.6	...	101.2	...	98.6	...	99	98.6	98.8	97.8	...	...
7	E.	99	99	...	100.2	...	K	...	99	98.6	98.8	97.8	...	...
	M.	99.8	99.8	...	99.4	...	...	...	...	...	...	98.6	...	...
8	E.	99.6	99	...	99	...	...	...	...	...	...	98.6	...	...
	M.	97.8	99.4	...	99.1	...	...	...	...	...	...	D	...	...
9	E.	100.2	100	...	99.8	...	...	...	...	...	...	...	...	...
	M.	98.8	97.2	...	...	...	...	...	...	...	...	...	...	...
10	E.	100	...	...	...	...	...	...	...	...	...	...	...	...
	M.	99.6	D	...	98.6	...	...	...	...	...	...	...	...	...
11	E.	98.4	...	...	...	...	...	...	...	...	...	...	...	...
	M.	99.6	...	...	...	...	...	...	...	...	...	...	...	...
12	E.	98.8	...	...	...	...	...	...	...	...	...	...	...	...
	M.	100.2	...	...	...	...	...	...	...	...	...	...	...	...
13	E.	98	...	...	...	...	...	...	...	...	...	...	...	...
	M.	99.2	...	...	...	...	...	...	...	...	...	...	...	...
	E.	99.4	...	...	...	...	...	...	...	...	...	...	...	...
Highest temp.	M.	100.2	100.1	100.2	102.2	100	...	99.6	100.6	101.6	99.8	102	...	...
	E.	102	102.4	104.8	100.6	102*	...	101	100.1	102.6	101.7	100.1	...	...
Lowest temp.	M.	96.4	97.2	95.2	97	96.4	...	95	96	95.2	95.4	98	...	...
	E.	95	95.7	98.5	97.6	97	...	96.8	96	100.1	96.8	97.4	...	...

D = Died.

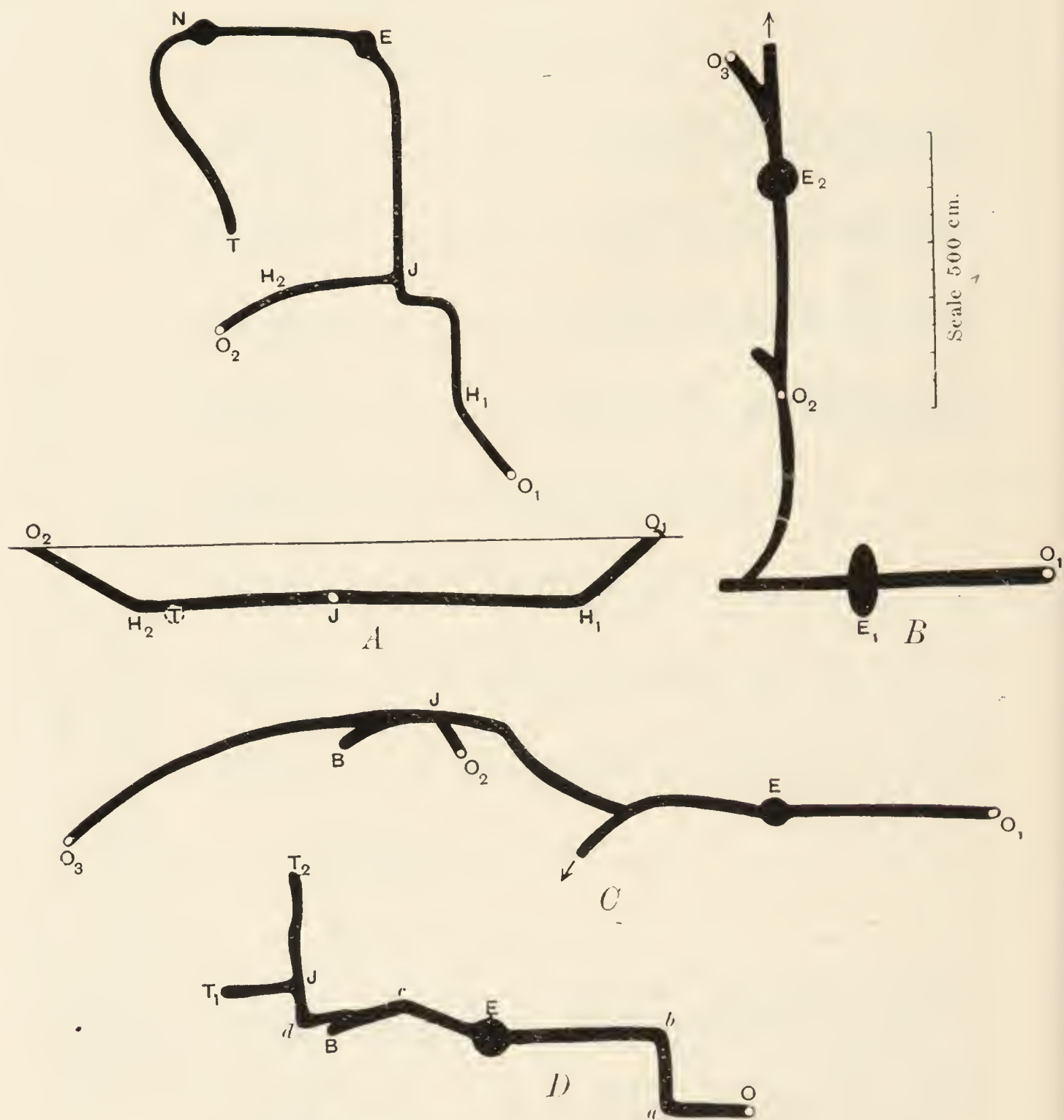
\* Animal escaped; temp. taken just after recapture.

K = killed.

a = inoculated with *Bacillus anthracis*.



## APPENDIX II.



*Tarbagan Burrow A.* Near Manchouli. Opened Aug. 19th, 1911.

$O_1$ ,  $O_2$ , entrances to the burrow. J, junction of the tunnels from entrances  $O_1$ ,  $O_2$ . E, enlargement containing faeces. N, enlargement containing "nest." T, terminus. Diameter of entrance  $O_1$  21 cm. Diameter of entrance  $O_2$  28 cm.  $O_1$  to  $H_1$  195 cm.  $O_2$  to  $H_2$  239 cm.  $H_1$  to J 452 cm.  $H_2$  to J 355 cm. J to E 276 cm. E to N 284 cm. N to T 479 cm. Whole length from  $O_1$  to T 1633 cm. Diameter of E 72 cm. Diameter of N 58 cm. Distance from  $O_1$  to  $O_2$  623 cm. Depth at J 102 cm. Depth at T 124 cm.

*Tarbagan Burrow B.* Near Manchouli. Opened Aug. 19th, 1911.

$O_1$ ,  $O_2$ ,  $O_3$ , entrances to burrow.  $E_1$ ,  $E_2$ , enlargements. Diameter of entrance  $O_1$  23 cm. Distance from  $O_1$  to horizontal 304 cm.  $O_1$  to  $E_1$  308 cm. Size of  $E_1$  140 by 50 cm.

*Tarbagan Burrow C.* Near Manchouli. Opened Aug. 22nd, 1911.

O<sub>1</sub>, O<sub>2</sub>, O<sub>3</sub>, entrances to burrow. E, enlargement. J, junction of tunnel from entrance O<sub>2</sub>. B, blind end. From entrance O<sub>1</sub> the tunnel sloped downwards to E, a distance of 304 cm.

E to J 725 cm. J to B 177 cm. J to O<sub>3</sub> 780 cm. Deepest part of the burrow 110 cm. The blind end B connected with the surface. From O<sub>2</sub> to O<sub>3</sub> the ground was very stony.

*Tarbagan Burrow D.* Near Manchouli. Opened in March 1911.

Measurements taken in Aug. 1911.

This was one of the Burrows opened by the Finn hunter in March 1911 to obtain Tarbagans for the International Plague Conference. When opened the ground was frozen and the Tarbagans were hibernating.

O, entrance to the burrow. E, enlargement. B, blind end. T<sub>1</sub>, T<sub>2</sub>, Tarbagans found here by the hunter.

O to a 166 cm. a to b 142 cm. b to c 385 cm. c to B 142 cm. B to d 72 cm. d to J 72 cm. J to T<sub>1</sub> 129 cm. J to T<sub>2</sub> 213 cm.

### APPENDIX III.

Translation of the Chinese Order prohibiting the hunting  
of Tarbagans (April, 1911).

*Prohibition Order regarding Tarbagan Hunting,  
Hsuan Tung, 3rd Moon, 20th Day.*

By The HULUN TAOTAI.

1. Anyone found in possession of traps or other instruments for catching Tarbagans is liable to have these traps or other instruments confiscated and will not be allowed to continue to hunt.
2. Any cart found conveying Tarbagans or Tarbagan skins is liable to confiscation. The driver of the cart and the hunter will be punished.
3. Any tent intended for the use of Tarbagan hunters and any Tarbagan skins found by the Government officials are liable to be burnt and any hunter found disobeying this Order will be punished by 6 months' imprisonment.
4. No Chinese or Russian is allowed to sell Tarbagan skins. Anyone found disobeying this Order will be arrested and handed over to the proper authorities for punishment.
5. Any Chinese disobeying this Order will be tried by the local authorities. Any Russian disobeying this Order will be handed over to the Russian authorities for trial.

The above Orders are made in order to prevent a recurrence of Plague.



Table of temperature observations in Fuchiatien (Harbin).

SERIES A.

No. of obs.	Variety of dwelling	Description of building	No. of persons at the time	Approx. size of room, in feet		How heated	Did plague occur here? Few or many?	Temp. inside room, C.	Temp. outside room, C.	Date	Time of day taken
1 a	Native Inn	Mud walled room, old, no windows, native kang on both sides.	11								
1 b		Ground of room about 1 ft. lower than that outside the door. Earth floor	15	23	19	12	Brick stove with chimney	Not sure	10	-3	2/2/13
2 a	Native Inn	Brick wall outside, mud inside, earth floor, 1 window, kang on both sides leaving passage in the middle	11	19	16	9	Brick stove with chimney	Not sure	7	-2	
2 b			12						10	-4	10.00 p.m.
3 a	Native Inn	Earth floor, paper windows 6, kang on both sides	12	26	19	7	Brick stove with chimney	?	12	-2	do.
3 b			12						11	-5	11.00 p.m.
4 a	Native Inn	Plank floor, native kang on both sides, 2 paper windows	14	23	20	8	Open charcoal pan	?	10	-2	do.
4 b			14						14	-5	4.00 p.m.
5 a	Native Inn	Earth floor ...	12	18½	16½	9½	Stove with chimney	?	17	-2	do.
5 b			12						22	-5	10.00 p.m.
SERIES B.											
6 a	Native Inn	Plank floor, kang on both sides of room, glass windows	22	17	17	7	Open charcoal pan	?	16	-3	3/2/13
6 b			8						22	-10	10.00 p.m.
7 a	Native Inn	Plank floor ...	8	16	19	7	Kangs	?	16	-3	do.
7 b			9						17	-10	11.00 p.m.
8 a	Native Inn	Earth floor, kang	8	19	19	7	Kangs	?	14	-4	do.
8 b											
9 a	Native Inn	Earth floor, mud and straw wall, 4 paper windows	14	19	19	10	Chimney stove	?	10	-3	do.
9 b			14						11	-7	8.00 p.m.
10 a	Native Inn	Plank floor, 1 window	7	0	10	0	Chimney stove	?	12	-3	do.
10 b											

Inn	23	21	9	Kangs	?	16	- 8	do.	
11 <i>b</i>	0								10.00 p.m.
SERIES C.									
12 <i>a</i> Native Inn	14	19	9	Stove with chimney	?	10	- 3	4/2/13	3.00 p.m.
12 <i>b</i>	0					13	- 7		9.00 p.m.
13 <i>a</i> Native Inn	8	12	9	Stove with chimney	?	13	- 8	5/2/13	4.00 p.m.
13 <i>b</i>	8					18	- 15		8.00 p.m.
14 <i>a</i> Native Inn	5	7	12	Open charcoal pan	?	15	- 9	do.	5.00 p.m.
14 <i>b</i>	5					18	- 17		9.00 p.m.
15 <i>a</i> Native Inn	9	21	8	Stove with chimney	?	21	- 8	do.	8.00 p.m.
16 <i>a</i> Private	2	19	7	Stove with chimney	?	16	- 15		2.00 p.m.
16 <i>b</i>	2					17	- 19	6/2/13	9.00 p.m.
SERIES D.									
17 <i>a</i> Native Inn	12	23	19	7 Stove with chimney	?	9	- 19	7/2/13	1.00 p.m.
17 <i>b</i>	11					8	- 24		9.00 p.m.
18 <i>a</i> Shop	3	10	21	7 Stove with chimney	?	11	- 16	do.	2.00 p.m.
18 <i>b</i>	2					15	- 24		8.00 p.m.
19 <i>a</i> Native Inn	11	28	19	9 Stove with chimney	?	13	- 17	do.	2.00 p.m.
19 <i>b</i>	11					14	- 23		8.00 p.m.
20 <i>a</i> Native Inn	11	28	19	9 Open charcoal pan	?	11	- 18	do.	3.00 p.m.
20 <i>b</i>	11					14	- 24		9.00 p.m.
SERIES E.									
21 <i>a</i> Native Inn	12	19	16	7 Charcoal pan	?	14	- 18	8/2/13	2.00 p.m.
21 <i>b</i>	13					16	- 22		7.00 p.m.
22 <i>a</i> Native Inn	9	40	19	9 Stove with chimney	?	12	- 18	do.	3.00 p.m.
22 <i>b</i>	12					19	- 23		8.00 p.m.



Table of temperature observations in Fuchiatien (Harbin) (continued).

SERIES E (cont.).									
No. of obs.	Variety of dwelling	Description of building	No. of persons at the time	Approx. size of room, in feet L. B. H.	How heated	Did plague occur here? Few or many?	Temp. inside room, C.	Temp. outside room, C.	Time of day taken
23 a	Native Inn	Earth floor, kang on both sides of room, lighted once every evening	12	19 19 9	Charcoal pan, no chimney	?	4	-14	9/2/13 1.00 p.m.
23 b			11				2	-23	10/2/13 2.00 a.m.
24 a	Native Inn	Earth floor, kang on both sides, burned once every evening, paper windows	7	16 19 9	Charcoal stove with chimney	?	8	-15	9/2/13 12.30 p.m.
24 b			7				5	-23	10/2/13 2.00 a.m.
25 a	Native Inn	Earth floor, kang on both sides, paper window on one side	16	21 19 9	Coal stove with chimney	?	11	-15	9/2/13 3.00 p.m.
25 b			18				13	-23	10/2/13 12.30 a.m.
26 a	Native Inn	Earth floor, kang on both sides	12	19 19 9	Coal stove	?	8	-15	9/2/13 3.00 p.m.
26 b							14	-23	12.00 p.m.
SERIES F.									
27 a	Native Theatre	Wooden floor, all windows on top, natural vent	About 900	85 90 65	2 big brick stoves each 6 x 3 x 3	Yes, many	11	-22	9/2/13 11.00 p.m.
28 a	Native Inn	Earth floor, kang on both sides, lighted once every evening, burn straw, 2 paper windows, dome-shaped roof	15	19 19 9	One charcoal pan without light	?	10	-10	10/2/13 11.00 a.m.
28 b	Room A		13		One burning		5	-20	11/2/13 2.00 a.m.
29 a	Native Inn	Do.	7	19 19 9	Only one charcoal pan, unlighted	?	5	-10	10/2/13 11.30 a.m.
29 b	Room B		16				12	-20	11/2/13 2.00 a.m.
30 a	Native Inn	Do.	20	19 19 9	No stove or pan, but kang on both sides	?	12	-10	10/2/13 12.30 p.m.
30 b	Room A		16				11	-20	11/2/13 1.30 a.m.
31 a	Native Inn	Do.	10	19 19 9	One charcoal pot with no chimney	?	11	-10	10/2/13 12.30 p.m.
31 b	Room B		11		Burning		10	-20	11/2/13 1.30 a.m.

32	Native Theatre	As obs. 27	...	...	650	85	90	65	Obs. 27	Yes	9 d'stair - 6 11 upstairs	16/2/13	2.00 p.m.
SERIES G.													
33 a	Private Room A	Earth floor, kangs on both sides, 2 paper windows	3	9	14	7			Charcoal pan, lighted	Yes	10	-7 11/2/13	4.00 p.m.
34 a	Private Room B	Same as above, dome-shaped roof	11	19	19	9			Charcoal pan, but without fire	Yes	11	-7 do.	4.00 p.m.
35 a	Carpenter's shop	Earth floor, kangs both sides, one window papered	5	19	12	...			No stove or charcoal pan whatever	Yes	0	-9 do.	5.00 p.m.
36 a	Cake shop	Same as above	2	19	9	7			Only kang	Yes	6	-6 do.	2.00 p.m.
37 a	Private	Same as above	4	19	9	...			Only kang	Yes	4	-6 do.	2.30 p.m.
38 a	Lodging House	Earth floor, 6 paper windows	8	33	19	...			Kangs, charcoal pan with fire	Reported to have occurred	10	-7 12/2/13	1.00 p.m.
38 b			18								6	-19 13/2/13	1.30 a.m.
SERIES H.													
39 a	Eating House	Earth floor, 2 paper windows, kangs on either side	5	16	16	7			Charcoal pan, burning	Yes	1	-7 12/2/13	2.00 p.m.
39 b			5								5	-19 13/2/13	1.30 a.m.
40	Private	Same as above	13	21	21	7			Stove with chimney, not lighted	Yes	12	-7 12/2/13	2.00 p.m.
41	Private	Same as above	4	23	9	7			Charcoal pan, burning	Yes	8	-6 do.	3.00 p.m.
42	Private	Earth floor, kang on both sides, 2 paper windows	3	9	16	9			Charcoal pan, burning	Yes, many	13	-7 13/2/13	4.00 p.m.
43	Private	Earth floor, kang on both sides, 1 window	2	16	9	12			Stove with chimney, no fire	Yes, many	14	-6 do.	5.00 p.m.
44	Small Inn	Same as above, but brick wall	2	9	19	7			Stove with chimney, burning	Yes, over 10 persons	16	-6 do.	3.00 p.m.
45	Private	Plank floor, kang on one side, glass windows	6	...	...	...			Chimney stove with fire	...	18	-7 do.	4.00 p.m.



Table of temperature observations in Changchun.

SERIES A.									
No. of obs.	Variety of dwelling	Description of building	No. of persons at the time	Approx. size of room, in feet L. B. H.	How heated	Did plague occur here? Few or many?	Temp. inside room, C.	Temp. outside room, C.	Time of day taken
1	Chinese Hotel	Plank floor; one glass window at the back wall, an entire glass window in front wall open to the yard. A kang inside room	1 Med. Off. himself	22 11 12	1 kang, charcoal pan burning, a stove with chimney extending from next room	No. Built after the epidemic	7	-3	1.00 a.m.
2	Chinese Theatre	Plank floor; a "U" shaped amphitheatre facing the stage, glass windows on all sides but always closed in cold weather. About 600 seats	About 370	150 70 50	3 stoves with chimney at corners of ground floor	No. Built after the epidemic	5	-3	6.00 a.m.
3	Small Hawker's dwelling	Earth floor; oppos. kangs; dark; 2 paper windows about 2 sq. ft. each	7	13 19 8	1 small charcoal pan kept burning	Yes	-3	-7	22/2/13 3.00 p.m.
4	Hawker's shop	Earth floor; 1 kang, 2 sky-lights, 2 paper windows. Part of room used for cooking	7	19 13 6	Earthen pot burning charcoal	Yes	1	-7	22/2/13 3.00 p.m.
5	Coolie hut	Earth floor; one side of the room used. Kaoliang stalks as a partition. 2 paper windows; 1 kang	13, all on the kang for warmth	19 13 8	No stoves, kang lighted once or twice a day for food	Yes	1	-8	22/2/13 3.00 p.m.
The houses of obs. 3, 4, and 5 are situated 2 miles from Changchun, so it was not easy to make the second observation.									
SERIES B.									
6	Public Bath	Cement floor; glass windows in front wall, wooden benches along all sides of wall; bright but air-tight	12	34 20 11	Chimney stove burning coal	Yes, over 30	23 taken at corner of room	-8	22/2/13 4.00 p.m.
7	Chinese Inn	Earth floor; 1 kang, wooden partition dividing room into two portions. 2 paper windows behind the kang	10 14	10 9 8	Stove burning coal in one of the rooms	Yes, but not this room; the infected room is now locked up	13 14	-8 -15	22/2/13 4.30 p.m. 22/2/13 11.00 p.m.
							21	-8	22/2/13 5.15 p.m.

9	Chinese low class Inn	Earth floor, damp, dark; 3 kang; paper window; dome-shaped roof	11	20	18	22	10	Stove with chimney, burning	No	16	-8	23/2/13	12.30 p.m.
10	Private Residence	Earth floor, dark and damp; 2 kang. Kaoliang (millet) stalk roof; conical shape; paper window, half room used as kitchen	5	6	17	21	9	No stove but a square brick stove for cooking	Yes, all in house were carried off by plague	0	-8	23/2/13	1.00 p.m.
SERIES C.													
11	Chinese Inn	Plank floor, paper window, walls lined with paper have not been torn down after the epidemic, but have had a little alteration since then	6	10	20	13	9	Stove with chimney extending into it from next room	Yes	9	-8	23/2/13	1.00 p.m.
12	Police Station	Earth floor, oppos. kang; paper window, damp and dark; mud wall, kaoliang stalk roof	18	29	37	18	10	No stove whatever, kang burned twice a day	Yes, 24 out of 25 persons	11	-5	24/2/13	2.00 p.m.
13	Chinese low class Inn	Earth floor, oppos. kang; street wall has 2 paper windows about 3 sq. ft., 1 window at back wall, paper ceiling, mud wall	11	16	16	16	9	Only 2 kang that receive warmth from 2 cooking stoves outside	Yes	3	-14	25/2/13	6.00 a.m.
14	Chinese low class Inn	Earth floor, 3 kang like a ㄇ shape; oppos. walls, both were paper lined, 3 square brick stoves attached to each of the kang, old and damp	13	24	32	33	11	Only the 3 brick stoves for cooking	Yes, about 3 or 4 persons lost their lives here	5	-9	24/2/13	3.00 p.m.
15	Chinese low class Inn	Earth floor, oppos. kang; paper window on street side, old and wet	5	5	20	17	9	An open charcoal pan	Yes	5	-5	24/2/13	3.30 p.m.
SERIES D.													
16	Chinese Inn	Earth floor, shaped kang, 1 paper window, 1 brick stove for cooking. Kaoliang stalk roof	20	20	34	20	10	One charcoal pan, burning	Yes	8	-6	25/2/13	5.00 p.m.
17	Wagon maker	Earth floor, 3 paper windows on one side, damp, 3 flat cooking stoves, mud wall	25	23	24	22	10	Only the 3 stoves attached to the kang burned when cooking	Yes	9	-6	25/2/13	5.00 p.m.
										9	-18	26/2/13	3.00 a.m.



## APPENDIX IV.

*Temperature Observations in Fuchiatien (Harbin) and in Changchun.*

In reply to a request made by Dr Oscar Teague (American delegate to the Mukden Plague Conference) for particulars of temperatures inside and outside houses of towns where the epidemic of 1910-11 had been most severe, *e.g.* Fuchiatien, Changchun, the observations comprising this Appendix were made under the personal supervision of Dr T. N. Tang, Assistant Medical Officer. The following is a summary of the recorded on pp. 56-61 data:

1. *Re Observations in Fuchiatien.*

1. The native dwellings are heated by :
  - (a) brick stoves after the Russian style (very few);
  - (b) iron stoves in which coal is usually burnt;
  - (c) *K'angs*, *i.e.* large rectangular mud and brick structures 2 feet above the ground on which the people sit and rest, heated usually by millet stalk;
  - (d) open charcoal pans without chimneys.
2. The windows consist usually of a wooden framework pasted with thin white paper, thus letting in very little light.
3. Besides the doors and the cracks in the windows, walls, and roofs, there is seldom any ventilation inside the dwellings.
4. The following are some of the more interesting observations :
  - (a) Period of observation, February 2nd to 13th, 1913.
  - (b) Number of dwellings examined 44.
  - (c) Number of observations taken 75.
  - (d) Highest temperature recorded
 

{	outside	-	2° C.
{	inside		22° C.
  - Lowest           "           "           "
 

{	outside	-	24° C.
{	inside		0° C.
  - (e) Average           "           "           "
 

{	outside	-	11.5° C.
{	inside		11.7° C.

2. *Re Observations in Changchun.*

- (a) Period of observation, February 21st to 26th, 1913.
- (b) Number of dwellings examined 17.
- (c) Number of observations taken 28.
- (d) Highest temperature recorded
 

{	outside	-	3° C.
{	inside		23° C.
- Lowest           "           "           "
 

{	outside	-	20° C.
{	inside		-3° C.
- (e) Average           "           "           "
 

{	outside	-	10.2° C.
{	inside		8° C.

#### IV. "NOTES ON THE HISTOLOGY OF SOME OF THE LESIONS FOUND IN PNEUMONIC PLAGUE."

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AND

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(With Plates XII—XV.)

THE lesions of bubonic plague and of plague produced experimentally have been fairly fully described, especially with regard to the naked-eye appearances of the lymphatic glands, lungs, liver, kidney, spleen, and heart; but it was not until comparatively recently, in the outbreak of the great pneumonic plague in Manchuria, that an opportunity occurred of studying at all fully the histology of the lesions met with in this condition. Since this outbreak, however, a number of observers, working in the plague field, or on material supplied by these workers, have dealt somewhat fully with the pathological anatomy and histology of primary and secondary pneumonic plague, and have made no slight contribution to the hitherto scanty literature of the subject.

Our material is from patients who succumbed to pneumonic plague in the Manchurian epidemic. At first, the lesions of the heart and liver attracted our attention as most requiring investigation; but later we determined to examine the whole of the material at command and we now describe it in the following order:—lung, bronchial glands, heart muscle, liver, spleen, and kidney.

We make no attempt to generalise as to the types of lesions met with in pneumonic plague patients, but offer a note of the actual conditions seen in material prepared in Manchuria and examined at Cambridge, and of those naked-eye appearances only that are presented



## 64 *Histology of the Lesions in Pneumonic Plague*

in small pieces of tissue transmitted to Cambridge. We then compare our findings with those of certain other observers.

The material available for examination consisted of a fragment of heart muscle from a case of pneumonic plague; a fragment of liver from a case possibly, but not necessarily the same as, the above; and pieces of well-preserved lung, bronchial glands, spleen, liver, and kidney tissue from a second (or a third) case. It is impossible to say much concerning the naked-eye appearance of the solid organs, of which only small pieces, fixed and hardened in formalin and formol glycerine, are available; but a few points of interest are noted, as each organ is dealt with.

We think it well, however, before dealing with our own material, to give a short account of the appearances described by different investigators, especially as considerable differences of opinion exist amongst them as to the exact nature of the lesions—particularly of the lesions found in the lung—in cases of pneumonic plague.

LUNG.—Wilm (1897<sup>23</sup>) examined the lungs from a number of his Hong Kong cases in 1896. Intense congestion, oedema, and well-marked infiltration were found in the lower lobe in five cases, evidently pneumonic. The bronchi were usually unaltered though in some there was congestion of the mucous membrane with a considerable quantity of mucus on the surface.

Wyssokowitz and Zabolotny (1897<sup>24</sup>) speak of the pneumonia as of a broncho-pneumonic type accompanied by bronchitis, the foci in the primary plague pneumonia becoming numerous and confluent in the later stages, producing a lobar consolidation. They describe a secondary pneumonia resulting apparently from the extension of the disease from the blood-vessels. These observers never found the pneumonia occupying the whole lobe of a lung. In the small and medium-sized bronchi the mucous membrane was red and covered with greyish mucous fluid sometimes stained with blood and mixed with air.

Yamagiwa (1897<sup>25</sup>) describes the catarrhal pneumonic condition in the consolidated patches of which the vessels are congested. The interalveolar septa are infiltrated with red blood corpuscles and leucocytes, similar cells filling many of the alveoli, in which filaments of fibrin and degenerating alveolar epithelium may also be seen. Almost pure cultures of plague bacilli may be found in the blood-vessels and in the alveoli.

Albrecht and Ghon (1898–1900<sup>1</sup>) also describe primary plague pneumonia as a typical lobular or broncho-pneumonia, usually most marked in the posterior portion of the lung, the patches of consolidation sometimes becoming confluent though, frequently, areas of congested but air-retaining lung lie between them. These authors draw attention to the fact that the pleura over the consolidated areas may be slightly cloudy or deeply injected, that there may be numerous small haemorrhages or—in this the condition differing essentially from an ordinary catarrhal pneumonia—the pleura may be covered with a layer of fibrinous lymph. They



describe a very characteristic appearance of the septa of the alveoli which become much broadened, appearing as a glistening homogeneous framework which stains well with eosin. In this network are a few cells or cell nuclei and red blood corpuscles. They also note the disappearance of the interalveolar septa at certain points and that the dilated bronchi contain blood-stained fluid in which enormous masses of bacilli are embedded, but they point out that fibrinous exudate is almost absent, only a few solitary fibrils or a very delicate network being seen at wide intervals.

Childe (1898<sup>5</sup>) draws attention to the intense congestion and oedematous condition of the lungs; to the congestion of the bronchial mucous membrane and to the frothy watery fluid, sometimes blood-stained, that can be squeezed from the bronchi. He describes a number of pneumonic patches varying in size from that of a pea to that of an egg, light pink, red grey, or deep blood red in colour, solid and airless, rounded in shape and separated from the crepitant lung by a distinct ring of engorgement. Those of the patches which were situated on the surface of the lung projected from the surface whilst "the pleura over them was roughened and showed signs of early inflammation." He likens such patches to those of the 1st and 2nd stages of ordinary lobular pneumonia. There never was any softening or breaking down. Sometimes these pneumonic patches were much larger and occupied a considerable part of the lobe. Petechial haemorrhages were sometimes present on the surface and the "bronchial glands were either enlarged, swollen, oedematous, soft and distinctly engorged" or else about the normal size and only slightly engorged. In a section of the lung the large blood-vessels and the interalveolar capillaries, between the pneumonic areas, are greatly engorged; there are also small haemorrhages into the alveoli between which the engorged vessels run.

He describes the pneumonic areas very much in terms of a broncho-pneumonia, dividing each area into three zones. In the outer of these there is intense engorgement of all the blood-vessels and capillaries in the walls of the alveoli, many of these alveoli being filled with blood. In some cases the alveolar septa are broken down and may be represented by mere shreds of tissue. In an intermediate zone the alveoli are intact and are filled with well-stained cells, evidently catarrhal, whilst in the centre of each pneumonic patch the alveoli are so stuffed with these cells that it is difficult to distinguish the outlines of the alveolar walls. In any or all of these zones haemorrhages may be present. The intermediate zone usually contains, in addition to the catarrhal epithelium, a few leucocytes and red blood corpuscles with, now and again, a few filaments of fibrin. In the dense central area catarrhal cells and leucocytes with some granular *débris* fill the alveoli. There is great congestion of the walls of the bronchial tubes and engorgement of the large veins in the walls of which haemorrhages are seen; and he states that "blood and catarrhal cells may be seen in the finer bronchi but the bronchial mucous membrane is scarcely altered, there being at most a little cellular proliferation. There are the appearances of acute pleurisy over those pneumonic areas which project upon the surface of the lung with haemorrhages beneath the pleura."

In the report of the Indian Plague Commission (1901<sup>26</sup>) the following interesting passage occurs: the lesions in primary pneumonic plague, "when contrasted with those occurring in *Pestis major*,...elsewhere than in the lungs are less intense,



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while those in the lungs are more intense" in which the large as well as the small blood-vessels are intensely congested and "haemorrhagic zones are seen scattered throughout the lung, filling the alveoli and often breaking down their walls. Within the haemorrhagic zones are areas in which the alveoli are completely filled with leucocytes, epithelial cells, and granular debris constituting, with surrounding zones of haemorrhage, blood congested areas of catarrhal pneumonia." The Commissioners point out that the bronchi are engorged with blood and that catarrhal cells are found at the terminations of these passages, and also that over the affected areas at the surface of the lung the pleura may be acutely inflamed. Agreeing with Major Evans (1901<sup>8</sup>), Captain Elphick (1901<sup>7</sup>) and Major Jones (1901<sup>26</sup>), they consider that croupous or lobar pneumonia is the form that occurs most frequently. The pneumonia is described as occurring in "small detached patches constituting lobular areas only when the inflammation has not far advanced; but it is lobar to the extent of involving a whole lobe or the greater part of a lobe when the lung inflammation has advanced further." Or again several cases are described "in which individual lobes or even an entire lung was consolidated." The Commissioners also lay stress on the fact that in many cases only slight changes were found in the bronchi and they suggest "that the pneumonia is lobular in patients who have died at an early stage of the disease and lobar in those who have survived to a later period; or, otherwise, that lobar pneumonia occurs when the toxin is most virulent and most widely distributed throughout the lung, and lobular pneumonia when it is less virulent and less widely diffused."

Hassan Hamdi (1904<sup>13</sup>), describing primary plague pneumonia, follows Yamagiwa pretty closely but points out that the alveolar epithelium even when desquamated contains in its substance red and white corpuscles and plague bacilli, whilst vacuoles can be seen in their protoplasm. Only a few isolated strands of fibrin can be seen in the alveolar contents. Bacilli may be found in the interalveolar septa and in the alveolar cavity. Where the bacilli are numerous the alveolar epithelium appears to be disintegrated, the mononuclear and polynuclear cells usually being collected in the centre of the alveoli where they are often surrounded by a ring or wreath of bacilli. The nuclei of the leucocytes are broken down, the interalveolar and interlobular septa are thickened, homogeneous and contain few nuclei, though they may be infiltrated with bacilli and with small round cells. Later this infiltration becomes so marked that the vessels can scarcely be seen and even the connective tissue fibrils are obscured. The most advanced changes and the earliest may be seen almost side by side in the same lung. The larger vessels of the lung are distended and congested, the tunica adventitia at first oedematous, later becomes infiltrated with leucocytes and bacilli. No special changes appear in the tunica media but in the connective tissue layer of the tunica intima there is a round cell infiltration. In many of these vessels the endothelium is detached or much swollen. Bacilli are comparatively few within the vessels; in the capillaries a number of giant cells similar to those met with in the bone marrow are sometimes found. The larger lymphatics contain red and white blood corpuscles, but little fibrin; the endothelial lining cells may be swollen. The connective tissue of the pleura, especially in the deeper layer, appears to be thickened and homogeneous, later it may become infiltrated with cells and there may be a laying down of fibrin and a wandering of leucocytes from the distended vessels. The pleural layer of endothelial cells has sometimes disappeared.



In the later stages of the pneumonia the lymphatics in the pleura may be filled with bacilli. This author describes secondary pneumonia as resulting from an extension of the disease from the blood-vessels to the septa and the alveoli. In these cases the blood-vessels are distended and filled with blood and the bacilli are very numerous, far more so than in the primary cases. In the alveolar septa the number of leucocytes is comparatively small but there are often many mast cells. In these cases, too, the alveolar epithelium is usually desquamated and the number of bacilli in the vessels may be so great that they form a kind of colourless clot; then the walls of the vessel giving way the bacilli make their way into the alveoli. The oedematous alveolar septa and alveoli contain numerous red blood corpuscles and bacilli and resemble those in a haemorrhagic infarcted lung. They sometimes contain an albuminous fluid which, on coagulation, is homogeneous and transparent. In this fluid many bacilli lying in groups or scattered singly between the cellular elements are found. Numerous alveolar epithelial cells, swollen and multinucleated, may be found alongside leucocytes. This desquamation and swelling of the alveolar cells is so characteristic a feature in the secondary pneumonias that where it is marked it may be accepted as being almost pathognomonic. The desquamated vacuolated alveolar epithelium shows in its protoplasm ingested bacilli, leucocytes and red blood corpuscles, and pigmented granules.

Strong (1912<sup>20</sup>), describing material taken from twenty-five autopsies made within a few hours after death, notes that delicate fibrinous adhesions are often observed between the parietal and visceral pleurae; also punctiform haemorrhages sometimes becoming confluent and forming larger dark red haemorrhagic patches. Fresh fibrinous pleurisy is present in every case, sometimes as a delicate reddish membrane. In other cases the fibrin is "greyish, or greyish-white and could be easily pulled from the surface of the lung; rarely, a gelatinous, oedematous, exudate was present. In two instances the pleural cavity contained between 100 and 200 c.c. of blood-stained fluid in which large numbers of plague bacilli were present." There are numerous ecchymoses beneath the pleura, and pneumonic infiltration and engorgement of some portion of the lung, the pneumonic areas being surrounded by zones of marked congestion and oedema from which a large quantity of reddish, serous fluid can be expressed. The pneumonic areas are either lobular or lobar in type, circular in outline or wedge-shaped and are usually paler at the centre than at the periphery. The mucous membrane of the bronchi is deeply congested. The broncho-pneumonic areas contain no air; cut sections have a dry, harsh and sometimes granular appearance and no mucous plugs can be expressed from the bronchi. An "entire lobe in a state of grey hepatisation such as is frequently found in ordinary croupous pneumonia due to the *Diplococcus pneumoniae*" is never met with, probably because the patient dies before this stage is reached. In one lung patches of lobular consolidation are noted while in another a whole lobe is involved. In the bronchi is a red, frothy, bloody, serous fluid, or a reddish mucous exudate, it is always blood-stained and often contains plague bacilli. In a later paper Strong in conjunction with Crowell and Teague (1912<sup>21</sup>) gives a somewhat fuller account of the histology of this condition. In no case examined were the lungs free from pathological change, bacteria occurring in enormous numbers especially about the bronchioles in the earliest cases, in the peribronchial lymph spaces and in the adjoining alveoli. They frequently form masses completely encircling the bronchiole and are



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present in large numbers in the interlobular septa beneath the pleura, following very closely the distribution of the carbon pigment present in such large quantities in these lungs. In the cases that succumb quickly few bacilli are found in the blood and although the alveoli contain bacilli the lining epithelium is, as yet, but slightly altered. The blood-vessels and capillaries are widely distended, are sometimes ruptured and smaller haemorrhages may be seen around them. There is catarrhal inflammation of the smaller bronchi and bronchioles, swelling and some desquamation of the epithelium, and a few red blood corpuscles and leucocytes may be found amongst the epithelium and in the lumen of the bronchioles; on the surface, mucus and large numbers of bacilli may be found. In this early stage the alveoli may be almost filled with bacilli and contain a few desquamated epithelial cells, serum, and an occasional leucocyte or red blood cell. In the later stages a larger number of leucocytes and red blood corpuscles are found in the alveoli, the red corpuscles always preponderating, though the leucocytes, both polymorphonuclear and mononuclear, become more numerous as the disease advances. Few, if any, eosinophile cells are met with. There is fragmentation of the nuclei of the leucocytes. The leucocytes, when seen under high magnification, are, very frequently, surrounded by a clear zone. Phagocytosis was seldom observed. Strong comments upon the absence of fibrin from the exudate in most cases and maintains that, when present, it is found in small quantities only. In the later stages of the disease the bacilli are very numerous especially in the medium sized vessels, in the lymphatics of the deep layer of the pleura and in the fibrinous exudate which always covers the pleura over the consolidated areas.

The mucous membrane of the bronchi is intensely congested and thrown into a series of longitudinal folds.

Dr Akira Fujinami (1912<sup>11</sup>) made 29 autopsies in Manchuria, three of them on animals. He considers that intense congestion and great oedema of the lungs characterised the pneumonia and preceded a form of hepatisation which is peculiar to plague. The lung is harder to cut but not very compact, the surface of a section is not so granular as in ordinary croupous pneumonia and the consolidation is very patchy, sometimes dark red, sometimes greyish-red or greyish-yellowish-red; the red tinge is seldom absent. In some cases there are no well-developed areas of local hepatisation; the lungs simply look congested. Any part of the lung may be affected but the consolidation was noted most often in the right upper lobe, then in the left upper lobe and then in the lower lobe. In only one case was the right middle lobe the special seat of the hepatisation. On histological examination hyperaemia of the blood-vessels and capillaries of the lung is observed; serous fluid, numerous leucocytes and red blood corpuscles and desquamated epithelial cells in variable quantity are present in the alveoli of the hepatised area. Fibrin threads within the alveoli are rare or almost absent and in the non-hepatised areas an oedematous fluid containing a few leucocytes may fill the alveoli. Plague bacilli are numerous in the alveoli, not only in the hepatised areas but even where there is no inflammatory cellular exudation. Bacilli also occur in and around the blood-vessels and bronchial walls, in the perivascular and peribronchial lymphatics and in the subpleural tissue. Single bacilli or small colonies are seen in the blood-vessels whilst other organisms sometimes accompany the plague bacilli. This author, with Strong, describes a fibrinous membrane covering the pleura especially over the hepatised areas.



Dr Koulecha (1912<sup>14</sup>) describes 28 cases and speaks of a true fibrinous lobar or pleuro-pneumonia, the pleura always being covered with a fine fibrinous layer, although, as he admits, there is a lack of fibrin in the exudate into the alveoli, this exudate consisting of a serous fluid in which a variable number of red blood corpuscles and leucocytes appear, the proportion of these different corpuscles determining to some extent the depth of the colour of the pneumonic patch. The desquamation of the epithelium of the alveoli is not a marked feature and the exudate is not catarrhal in character. This exudate contains an enormous number of plague bacilli which also accumulate both in the perivascular lymphatics and in the blood-vessels whence, with their products, they pass from the blood-vessels into the alveoli of the lung.

Signorelli (1913<sup>19</sup>) set out to ascertain whether in plague the pneumonia is fibrinous or of the catarrhal type. He quotes Lustig and Galeotti (1897-1901<sup>16</sup>) and Galeotti (1900<sup>12</sup>) as able to produce intravascular coagulation by means of injections of the endotoxin or protein of *Bacillus pestis*. The so-called nucleo-proteids of plague injected into animals in suitable doses, they say, reproduce functional and histological changes similar to those that follow an ordinary infection. Federici (1898<sup>9</sup>), injecting these substances through the wall of the thorax of the rat or the rabbit into the substance of the lung, found that they set up great congestion of the interalveolar capillaries and damage and slight proliferation of the endothelium lining the alveoli, but he describes no increase of fibrin. Galeotti, injecting frogs, with the same material, into the lung substance as above, and guinea-pigs by the trachea, observed numerous haemorrhages and fibrinous clots in the alveoli. Examining the lung from a case of primary pneumonic plague sent from Mukden Signorelli found, however, that in the *dilated* alveoli cells of various types were embedded in a network formed of delicate threads of fibrin. In the alveoli the epithelium is markedly disintegrated though a few swollen cells with feebly staining nuclei adhere to the alveolar wall, and he insists that the alveolar content is only partly fibrinous, that the meshes in the network of fibrin are large and that the cells occupying them are crowded together and of various types:—lymphocytes, large mononuclear cells and polymorphonuclear leucocytes, the latter few in number, many of the large cells having a feebly staining protoplasm and a swollen vacuolated-looking nucleus. In the polymorphonuclear cells the nucleus is often undergoing pyknotic changes. Many of the large mononuclear cells are loaded with blood pigment; the exfoliated and degenerated epithelial cells of the alveolus may often be seen fairly distinctly. The bacilli are scattered in the alveoli between the cells of the exudate, rarely within them, phagocytosis, as far as the bacilli are concerned, being ill marked. Here and there are well-defined groups of bacilli lying free between the cells and around them a few fibrin filaments may be seen. One of the chief points noticed is the rapid desquamation of the alveolar epithelium, sometimes before it has time to proliferate. An important feature in all these preparations examined by Signorelli is rupture of the thrombosed and fragile capillaries and consequent breaking down of the alveolar septa. In some cases the bacilli appear to be multiplying not only in the alveoli but also in the lymphatics of the lung tissue as well as in the blood-vessels. Signorelli carried out a series of experiments on dogs, injecting the lungs with plague toxin or the nucleo-proteid of the plague bacillus, and showed that it produced localised areas of inflammation, diffuse



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hyperaemia around these areas and, usually, well-marked oedema of the pulmonary tissue; the vacuolated and degenerating epithelium covering the alveoli in such artificial injections was often desquamated, although no living plague bacilli were present. He looks upon the lesions in pneumonic plague as the result of an inflammatory process with fibrinous exudate and localisation of the fibrin in the pulmonary capillaries, this being due to the toxic and coagulative action of the nucleo-proteid of plague bacilli, and he lays it down that the thrombosis of the interalveolar capillaries is one of the factors which render pneumonic plague so serious. Sudden diminution of the respiratory area is produced by the blocking of the alveoli and of the capillaries and this is accompanied by a rapid and intense intoxication of the heart muscle, the toxin produced in the lungs passing rapidly, directly, and in large quantities into the chambers of the heart and, acting on the muscle, adds to the circulatory difficulties produced by the blocking of the pulmonary capillaries.

It is evident from these descriptions that in plague we have to deal with at least two types of pneumonia, and from a careful study of the literature and of the material now under examination we are satisfied that there are modifications even of these types. This we will consider after we have given a description of our material in which the following are the appearances presented.

*Lung.* There is some slight opacity of the pleura but on the surface of none of the pieces at our disposal is there even a trace of fibrinous lymph. At the pleural extremities of the trabeculae are deeply pigmented patches in which, however, there is little fibrous tissue formation such as is usually associated with the presence of carbon pigment. In most of the blocks there are no haemorrhages or petechiae either on the pleural surface or in the lung substance, but in one small piece three petechial haemorrhages about  $\frac{3}{4}$ " apart may be seen at the margin of the lung, probably a piece of the anterior border. Here and there are distinctly consolidated patches, some the size of a millet seed, some as large as a filbert, the latter predominating. Even from these areas a little air may be squeezed along with the preserving fluid, though the lung appears to be distinctly collapsed. As the pieces of lung are comparatively small, seldom more than 2" in length and 1" in breadth, it is impossible to determine the relative distribution of these patches. In one piece, apparently from the thin border near the base of the lung, the tissue has quite the normal, spongy, lung consistence and large quantities of air are, on pressure, squeezed out along with the fluid. Some of the large branches of the pulmonary artery seen on the cut surface contain distinct coagula or thrombi; in the consolidated areas this is well marked. A segment of the wall of a bronchus, about  $\frac{1}{4}$ " in diameter, is seen in one of the blocks. The mucous membrane, considerably congested, is thrown into folds and is covered with a thin layer of slightly blood-stained mucus.

*Histological examination of the lung.* At no point is there any evidence of a fibrinous pleurisy—there is no trace of fibrin on the surface—but a layer of well-preserved endothelial cells is seen either detached from the subjacent fibrous tissue or remaining *in situ* on



the surface of the pleura<sup>1</sup>. In these cells the chromatin network of the nucleus and a single or a double nucleolus are well seen; the protoplasm is vacuolated. The fibro-elastic tissue of the pleura is slightly thickened. The lymphatics and lymph spaces of the deep layer of the pleura are greatly distended with fluid or with dark brown or black granular pigment; the blood-vessels are greatly congested. Beneath the pleura and near the surface of the lung are alternate areas of collapse and emphysema. In the interalveolar septa of the collapsed areas there is intense congestion of the capillaries and considerable thickening of the basement membrane on which the alveolar epithelium rests (Plate XII, fig. 1); there is also some slight proliferation of the cells lying in the collapsed air vesicles; some of these proliferating cells contain brown pigment (Plate XIII, fig. 5). Around the blood-vessels, large and small, in the lymphatics of the deep layers of the pleura, in the peribronchial lymphatics and in the lymphatics of the fibrous trabeculae brown and black granular pigment may be seen in considerable quantities. In the depth of the lung the patches of collapsed alveoli are even more distinctly marked than immediately under the pleura. Here the catarrhal pigmented cells are very numerous, and the vessels are greatly congested. From the congested blood-vessels red blood corpuscles have escaped into the collapsed alveolar spaces. The swollen basement membrane, the fenestration of which is evident, of the walls of the alveoli looks as though it had absorbed a considerable amount of fluid. In areas where the collapse is not marked the air vesicles are distended with a coagulated albuminous fluid usually almost homogeneous, sometimes filled with little vacuoles (Plate XIII, fig. 5), or again, but rarely, containing a few delicate threads of fibrin. Leucocytes, accompanied or not by a few red blood corpuscles, may be seen lying free in these alveolar spaces, but there is no characteristic fibrinous lymph coagulum with white and red corpuscles such as is usually met with in the red hepatisation of the lung in lobar pneumonia. The process is rather one of intense congestion, collapse, and slight proliferation of epithelium and degeneration with marked oedema. Away from the pleura and from the collapsed patches large numbers of catarrhal cells, many of them containing carbon pigment, are seen in the alveolar spaces. In few of the pneumonic patches can traces of any granular fibrin be demonstrated by Weigert's fibrin stain. Lying in the delicate

<sup>1</sup> This is evidence of the excellent state of preservation of the tissues, which must have been placed in the fixing solution almost immediately after the death of the patient.



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granular network, when present, there may be a number of mononucleated epithelial cells (Plate XII, fig. 1) which appear to be derived by a catarrhal proliferative process from the epithelium lining the alveoli. In a few of the small collections of fibrin there is commencing mucoid change. Throughout our sections of the lung there is evidence of an oedematous condition—vacuolation of the cells, swelling and separation of fibres, and opening up of lymph spaces.

The consolidation of the lung tissue is very patchy, but where the alveoli are not collapsed or filled with proliferated epithelial cells they contain a hyaline albuminous fluid (Plate XII, fig. 1 and Plate XIII, fig. 5)—evidence of an oedematous condition. In the alveoli in which this is most marked the plague bacilli are also most numerous. In the capillaries between the alveoli the walls are distinctly thickened and hyaline, there is often evidence of great activity of the nuclei, marked thickening of the bodies of the endothelial cells and, along with this, thickening of the delicate collagenous tissue—basement membrane—on which these cells lie. Many of the capillaries are ruptured. Dark brown and black pigment of the same character as that described as occurring in the bronchial glands is present in the lymphatics of the interlobular septa, whilst a number of small, fibroid, nodules with deeply pigmented areas in which are few connective tissue or other cells are scattered throughout the section and are evidently the result of chronic irritation set up by inhaled carbon and dust particles. This though a chronic condition is apparently progressive. There is distinct pigmentation of the large and other fibrous septa, and in the perivascular and peribronchial tissue.

The appearances presented in the larger bronchi are interesting (Plate XII, fig. 2). Here and there the lining epithelium has almost disappeared, apparently by a process of rapid desquamation, from the basement membrane which is swollen, homogeneous and hyaline looking. Elsewhere, in place of desquamation, there is marked proliferation of the epithelial cells similar to that described by Hamilton as occurring in acute bronchitis and giving rise to the presence of numerous oval, "peg-top shaped" and rounded cells. The mucosa of the bronchus is thrown into folds through contraction of the peribronchial muscle. In some of the bronchi the columnar epithelial cells are distinctly more "goblet" in character than usual, the nucleus being pushed to one side, large droplets of mucus filling up the body of the cell. Sometimes the droplets of mucus have not run together but form a kind of foamy mass within the cytoplasm. On the basement membrane on

which the columnar cells appear to rest may be seen flattened cells not forming a continuous layer but occurring at intervals; in these cells the nuclei are more solid than are those of the other epithelial cells which are distinctly vesicular with a network of chromatin at the margin. In some of the larger branches of the bronchi smooth or slightly granular albuminous material may fill up the whole lumen. Beneath such a clot the epithelium is almost intact but seems to be throwing off large quantities of mucus from the large goblet cells. Debove's layer is also well seen, the basement membrane beneath being much swollen. There is slight cellular accumulation at certain points beneath the basement membrane. The pigment contained in the large cells and in the lymphatic spaces in the wall of the bronchus has evidently entered by way of the alveoli.

The thickened basement membrane in the acutely inflamed larger bronchi is very well brought out in the haematein and van Gieson stained specimen. The columnar and pear-shaped cells usually associated with an acute bronchitis are also specially well defined, though the superficial layer of cells has, in some instances, been completely removed. The thickened basement membrane seems to form an almost impenetrable layer though the distended vessels beneath come very close to its under surface. The vessels in the submucosa are greatly engorged. In some of the smaller bronchi the epithelium is well formed and almost intact, large globules of mucin which have absorbed fluid distending some of the cells.

The peribronchial lymph spaces contain much albuminous fluid (Plate XII, fig. 2). This same fluid has given rise to great thickening of the walls of the alveoli in the immediate neighbourhood of the bronchus. Around the smaller bronchi are localised accumulations of lymphocytes and polymorphonuclear leucocytes evidently called up chemiotactically.

In the bronchi the *Bacillus pestis* sometimes forms a regular layer on the surface of the epithelium, almost pure cultures being seen in the mucus covering them. They are found usually near the surface but, here and there, they appear to penetrate between the cells and down to the swollen basement membrane, which, however, forms a distinct barrier between the surface and the deeper connective tissue of the wall of the bronchus, and we cannot convince ourselves that there is a single bacillus in the substance of this basement membrane though in the vessels that come quite close to its under-surface plague bacilli are easily demonstrated (Plate XII, fig. 2). They are also seen attached



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to, and even inside the endothelial cells lining the arterioles in the walls of the bronchus. Except in the large bronchi where pure cultures of the bacillus may sometimes be seen a *comparatively* small number of bacilli are met with in the respiratory area, though, as already noted, small groups may be seen in the alveoli. At certain points, however, near the oedematous areas the disintegration of the cells and their nuclei is very marked, some of these cells being invaded by large numbers of bacilli, the breaking down cell being replaced by a mass of them. Bacilli are also seen in the perialveolar lymph spaces where they have evidently been carried by cells some of which also contain pigment. Here and there, what appears under the low power to be hyaline albumen, when examined under a higher magnification, is seen to consist of an almost pure culture of bacilli filling an alveolar space. Even in the collapsed alveolar spaces the plague bacilli are fairly numerous, most of them lying free, a few of them adherent to the large hyaline cells, but comparatively few being taken into the substance of the cells (Plate XII, fig. 1). In the albuminous (oedematous) coagula however the large phagocytic cells with more numerous contained bacilli may be seen.

In the larger branches of the pulmonary artery are well-formed blood thrombi embedded in which are a number of hyaline mononuclear cells. In the muscle fibre of the walls of these vessels swelling and vacuolation is very evident, whilst the endothelium lining the vessels is in a condition of cloudy swelling and is distinctly vacuolated. These endothelial cells usually stand out very distinctly. Bacilli are so numerous in some of the large vessels that masses of them looking like fibrinous clots may be seen under the low power. In the thrombotic clot bacilli may be seen, sometimes along the margins, in others embedded in it. In a vessel where the former arrangement is evident the bacilli are attached to the endothelium and are attacking it, and may even have brought about its complete disintegration, leaving a roughened fibrillar surface into which the bacilli may be seen making their way between the bundles of connective tissue and muscle fibre. Bacilli are seen in the vasa vasorum. They are certainly more numerous in the blood-vessels than in any other position except perhaps in the bronchial secretion and in a few alveoli, especially those containing coagulated albumen and cells. To the clots where the bacilli are numerous many leucocytes have been attracted, but where the bacilli are few the clot is almost devoid of leucocytes. In some of the medium sized and smaller vessels and in the interalveolar capillaries, the bacilli

in the ante mortem clots may be so numerous that they can be demonstrated in the haematein and van Gieson stained preparations. The endothelium in the blood-vessels is often in an advanced stage of cloudy swelling and may be the seat of a peculiar vacuolation, this, in some instances, causing a great increase in their size. Pyknosis of the nucleus is often noted. Bacilli may also be seen in the congested vessels of the deep layer of the pleura and a few in the perivascular and other lymphatics in this position. It is noteworthy that wherever the plague bacilli are seen lying on or near a basement membrane this membrane is almost invariably swollen and markedly hyaline. In the pigmented fibrous tissue bacilli may be seen in capillaries and also, though much more rarely, in the lymph spaces between the fibrous bundles.

In the congested interalveolar capillaries, the outlines of red corpuscles can rarely be made out, the capillaries standing out as yellow homogeneous irregular lines from which small haemorrhages are taking place into the surrounding alveoli. The interalveolar septa are considerably thickened, this partly from swelling of the basement membrane of the alveolar wall and partly from thickening of the basement membrane of the walls of the capillary vessels (Plate XII, figs. 1 and 3). The epithelial cells lining the alveoli are usually undergoing some proliferation leading, along with the collapse, to partial consolidation of small lobular areas. In these proliferating or catarrhal cells and in the epithelium lining the collapsed alveoli the nuclei are distinctly vesicular and the cytoplasm is vacuolated, but beyond this there may be no evidence of degeneration.

Hyaline cells with rounded and kidney-shaped nuclei may be seen in the alveolar spaces; some of these large cells contain ingested granules of black and brown pigment. In the alveoli and alveolar passages near the bronchi, in which there is an oedematous effusion, there is almost invariably a similar homogeneous exudate.

In the blood-vessels the phagocytic cells, especially the mononuclear cells, have taken up large numbers of plague bacilli (see Plate XII, fig. 4), but the alveolar epithelium (Plate XII, figs. 1 and 3) in the collapsed and catarrhal areas seems to have a certain slight power of ingesting even the *Bacillus pestis*, and in some of the cells, one or two bacilli have become enveloped in the cell protoplasm. Where the bacilli are numerous the nuclei both of leucocytes and epithelial cells take on a lighter stain, sometimes becoming distinctly vesicular or, again, undergoing pyknotic changes.



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*Bronchial lymphatic gland.* The macroscopic changes usually described in the bronchial glands of patients suffering from pneumonic plague are somewhat indefinite.

Strong, Crowell and Teague<sup>20, 21</sup> lay stress on the point that the bronchial glands near the bifurcation of the trachea show more advanced changes than do those in any other position. They maintain that they are "always swollen, rich in blood and frequently almost black in colour from the results of haemorrhages." Fujinami<sup>11</sup> confirms this and Koulecha<sup>14</sup> maintains that genuine buboes enormously rich in bacilli are found in these glands, indeed he maintains that they are very like the glands met with in other positions in bubonic plague. He notes that the bronchial glands always contain enormous numbers of plague bacilli, are softened, greatly congested, and embedded in oedematous tissue.

Childe<sup>5</sup> describes a similar condition in these glands, but he also notes, and in this he is corroborated by Yamagiwa<sup>25</sup> and Aoyama<sup>3</sup>, that these glands are not intensely affected whilst in some there may be no marked changes of any kind.

The bronchial gland of the lung here examined is, undoubtedly, slightly enlarged and congested; moreover it is deeply pigmented, but to the naked eye there is no evidence of haemorrhage or of any of those acute changes described by Childe and by Strong, Crowell and Teague.

On microscopic examination the appearances presented are fairly characteristic. Immediately under the capsule in the cortical sinuses a comparatively small number of plague bacilli may be seen, some lying free in the open network, others applied to the surface of the flattened endothelial cells lying on the swollen strands of the adenoid reticulum. In the vessels of the gland both large and small, as was to be expected, bacilli may be seen either lying free in the lumen, embedded in clot or in contact with the endothelial lining. It is difficult to say that they are contained within the endothelial cells, they look rather as though they are adherent to a viscid surface. Indeed, even the bacilli associated with the deeply pigmented cells appear in many cases to be adherent to their surface rather than to be taken into their substance. These bacilli are somewhat obscured by the presence of large quantities of dark brown or black pigment which has also been taken up by the endothelial cells lying on the swollen trabeculae of the adenoid reticulum. The swollen trabeculae look as though they have absorbed a considerable amount of fluid. Although there is fairly well-marked congestion of the vascular tissue of the gland there are no haemorrhages and there is certainly nothing of the nature of a bubo as described by certain observers.

HEART. Aoyama<sup>3</sup>, Wilm<sup>23</sup>, Lustig and Zardo<sup>17</sup>, Fujinami<sup>11</sup>, Strong, Crowell and Teague<sup>20, 21</sup> all describe in more or less detail, well-marked cloudy swelling of the muscle tissue of the wall of the heart. Aoyama<sup>3</sup>, Wilm<sup>23</sup>, Lustig and Zardo<sup>17</sup>, Fujinami<sup>11</sup> and Flexner<sup>10</sup> describe, in addition, fatty degeneration. On the other hand, Albrecht and Ghon<sup>1</sup>, who say that practically no change can be demonstrated microscopically, Hamdi<sup>13</sup> and Strong, Crowell and Teague observed or record no fatty degeneration of the fibres. Childe<sup>5</sup>, Yamagiwa<sup>25</sup>, Fujinami<sup>11</sup> and Strong, Crowell and Teague lay some stress on the "fragmentation" of the muscle fibres. Hamdi, however, is apparently not dealing with acute plague infection; it is not remarkable to find, therefore, that he notes the presence in the myocardium of a series of indurated nodules composed of fibro-connective tissue. He guards himself, however, by pointing out that as his specimens of muscle had been preserved in alcohol, he may be somewhat rash in stating that there is no cloudy swelling or fatty degeneration of the muscle. Childe, who gives the most complete account of the heart muscle as found in these cases of acute plague, after pointing out that many of the patients die suddenly of heart failure, notes that under the microscope some of the muscle fibres are well stained and distinctly striated, but that others stain very badly, and that in them the striation is "faint or absent, and the muscle substance is swollen, broken up into irregular lumps and of a shiny homogeneous appearance." This condition, he maintains, is associated with dilatation of the heart, and the liver is often in the "nutmeg" condition when examined post-mortem; but from our examination of the liver tissue from which our drawings (Plate XIII, figs. 6, 7 and 8) are made we are inclined to the view that the appearances presented in the liver in these cases are due to acute degeneration of the liver cells around the hepatic veins, and not to a chronic venous congestion. Strong, Crowell and Teague find fragmentation of the fibres of the heart muscle a constant feature in all the cases they examined. There is, then, considerable difference of opinion as to the exact lesions to be found in the heart muscle, but most observers describe dilatation of the right ventricle, especially of the conus (Fujinami), with thinning of its walls and a condition of general cloudy swelling of the muscle fibres of the heart, sometimes with fairly well-marked fatty degeneration. Epicardial ecchymoses are described by most of them, whilst only Strong, Crowell and Teague note a well-marked oedema of the heart muscle especially in the neighbourhood of the fragmented areas.

In the fragment of heart muscle at our disposal, there appears to be some slight oedema of the connective tissue on the surface of the heart, and running between the muscle fibres of the substance of the wall. On the epicardial surface is a distinct haemorrhage, the blood making its way along the lines of the connective tissue between the small collections of epicardial fat. In the oedematous, imperfectly staining,



epicardial tissue, and especially between the extravasated blood and the myocardium, are considerable accumulations of polymorphonuclear leucocytes, with here and there a few hyaline cells (Plate XIII, fig. 6). Beneath these accumulations, the heart muscle is somewhat oedematous looking, the spaces between the bundles of muscle tissue being of considerable size, the muscle being, as it were, dissected into little bundles, between some of which haemorrhages extend along the lines of the delicate interfascicular connective tissue. At intervals, especially near the surface of the myocardium, are areas in which slight proliferation of the nuclei, either of the sheath of the muscle fibre or of the capillaries, appears to have taken place. Moreover, this same sheath is considerably swollen and stands out very prominently, forming a kind of yellow, picric acid stained network between the muscle fibrils (Plate XIII, fig. 7). It is difficult to distinguish the outlines of the walls of the interfascicular capillaries as the red blood corpuscles appear to be "laked" and to have lost their outline. In many parts of the section, the transverse striation of the muscle fibre is greatly obscured. Here and there are seen vacuoles or collections of fluid actually within the muscle fibres, but no fat granules or globules can be distinguished. Where the muscle is least swollen, the transverse striation can still be made out, though there is marked cloudiness, but where the swelling is pronounced the granularity is lost and the muscle substance has become hyaline and highly refractive. Here also, it is undergoing distinct fragmentation (Plate XIII, fig. 8), apparently the result of traction by the more healthy transversely striated fibres upon the swollen hyaline and granular fibres. The fractures in these hyaline masses usually extend right across the muscle, half a dozen of such fractures lying close together. The condition corresponds very closely to the "vitreous degeneration" so fully described by Zenker in the abdominal muscles of patients succumbing to malignant typhoid fever. Commencing multiplication of the intermuscular endothelial cells may be made out very distinctly. Some of these proliferating endothelial cells are highly vacuolated, especially where there is other evidence of oedema—i.e. where the "dissection" of the muscle shows up the cells distinctly. The basement membrane lying between the endothelial cells of the capillaries and the muscle cell is distinctly swollen, even where the yellow tinting is absent.

**LIVER.** Most writers on the morbid anatomy and histology of plague describe small haemorrhages into the substance of the liver especially just beneath, or into, Glisson's capsule. All agree that

engorgement of the hepatic vessels is a marked feature, but Childe<sup>5</sup> states that engorgement and haemorrhages generally are not so marked in the liver of a patient dying from pneumonic plague as they are in the liver of those succumbing to the bubonic form of the disease. Yamagiwa<sup>25</sup> and Wilm<sup>23</sup> mention that the central hepatic vein and the capillaries in the central zone of the lobule are distended with red blood corpuscles. Aoyama<sup>3</sup> states that the interacinous vessels of the liver are, as a rule, markedly congested whilst surrounding these vessels and lying in the connective tissue are masses of round cells sometimes in considerable numbers. Wilm describes the liver in these cases as usually large and firm and the blood extravasations as varying considerably in size. He also points out that the boundaries of the lobules are often indistinct. Both these latter observers agree that in a few cases where jaundice has been present during life the liver may be greenish yellow in colour, and that cloudy swelling of the hepatic cells is always a marked feature, whilst Fujinami<sup>11</sup>, who was able to prepare the tissues for the demonstration of fat, found that the parenchymal cells contain fat droplets when stained with Sudan III. The cloudy swelling may be so far advanced that the nuclei become almost invisible. Hamdi<sup>13</sup> and Albrecht and Ghon<sup>1</sup> draw attention to the vacuolated, almost honeycombed, structure of the hepatic cells. They maintain that the vacuoles may contain fat but are unable to demonstrate it in their specimens as they have not been specially prepared. Most authors draw a distinction between pneumonic and bubonic plague in that in the former the so-called abscesses are absent, whilst in bubonic plague they are said to arise as the result of the impaction of emboli in branches of the hepatic artery (Albrecht and Ghon) or of the portal vein (Hamdi). Small necrotic areas surrounded by a haemorrhagic zone are described by Albrecht and Ghon. In these areas large numbers of plague bacilli may be seen, especially in the necrosed centre; at the periphery of these foci are numerous polymorphonuclear leucocytes and red blood corpuscles. Hamdi draws attention to the phagocytic activity of Kupffer's cells and the cells lining the portal capillaries. Strong, Crowell and Teague<sup>20, 21</sup> note that the small metastatic abscesses "occasionally observed in bubonic plague were not encountered in either the liver or the kidney" of cases succumbing to the pneumonic form of the disease. Plague bacilli and fowl-cholera-like bacilli, sometimes in large numbers, are described by Aoyama as present in the inter- and intra-lobular tissue.

The appearance of a section of the liver in which the most marked changes have taken place is, at the first glance, that of chronic venous congestion (Plate XIV, fig. 11). The enormously distended central vein of the lobule is, however, always filled with blood in which are small masses of coagulated fibrin usually attached to the wall of the vein, which may be considerably thickened. Around



the central vein and in an area corresponding to the central and intermediate zones, the capillaries are greatly congested, and the liver cells are represented merely by imperfectly stained nuclei and extremely granular and vacuolated fragments of protoplasm (Plate XIV, fig. 12). Some of the vacuoles may represent fat globules, but they appear to be rather accumulations of clear albuminous fluid, or perhaps even glycogen. It is, however, impossible to determine this in the hardened tissue. The walls of the portal capillaries are somewhat swollen and stand out very distinctly, but neither in the walls of the hepatic vein nor in the walls of these capillaries, nor again in the remaining fragments of liver cells, are there any pigmented granules such as we should expect to find were this a condition of chronic venous congestion (Plate XIV, fig. 12). The peripheral portions of the columns of liver cells stand out in marked contrast with the fragmented liver cells of the central zones with which, however, they are seen to be continuous. The whole picture, then, is that, not of a chronic venous congestion, but of an *acute red atrophy*. The hepatic cells at the periphery of the lobule are in a condition of extreme granularity and acute vacuolation, although there is no great increase in the actual size of the cells (Plates XIII and XIV, figs. 9, 12 and 13). The protoplasm of some cells may be simply granular; in others highly vacuolated; in others, again, the nucleus is surrounded by a ring of vacuoles which appears to separate it sharply from the granular protoplasm. In this peripheral area there is very marked swelling of the endothelial cells lining the capillaries, their nuclei are very distinct and their protoplasm stands out with great sharpness (fig. 13). In the degenerated area the endothelial cells, though retaining their outline, stain very badly and losing their nuclear stain appear to be merged into the thickened wall of the capillary vessel (Plate XIV, figs. 13 and 14). Though numerous fairly well-stained nuclei may be seen, few of them belong to the liver cells, in which the nuclei along with the remaining fragments of protoplasm are very imperfectly stained. Here and there, lying in the vascular channels, may be seen small accumulations of leucocytes or lymphocytes in some of which the nuclei are fragmented (figs. 12 and 14). These leucocytes, a few endothelial cells and one or two persisting liver cells, are the only structures in which stained nuclei can be seen, though a number of fragments of nuclear substance, stained and unstained, may be seen. Even the nuclei of the liver cells are, in many places, seen to be undergoing pyknotic disintegration. Contained within the capillaries, growing into their thickened walls and

sometimes grouped as though they had been contained in a liver cell, are enormous numbers of plague bacilli, a few of which appear to be adherent to the surface of the Kupffer cells (fig. 13), whilst others have been taken into their substance. Except where the liver cells are completely broken down, few plague bacilli are seen in their substance, unless they have made their way into the sinusoids of the cells (Plate XIII, fig. 9). A very characteristic feature in this condition is a translucent, thickened membrane which seems to form a kind of basement membrane between the capillary and the liver cells where the latter are present, and a kind of network where they have disappeared. In the somewhat larger branches of the hepatic vein, the endothelial lining cells are swollen, but their nuclei are still distinct. Here, too, the sub-intimal connective tissue has absorbed a considerable amount of fluid and is greatly thickened; it appears to be in a condition of "hyaline" degeneration. Many of the endothelial cells are detached and are embedded in a clot made up of granular fibrin, a large number of disintegrated red blood corpuscles and a few normal corpuscles. At a few points, taking the place of the disintegrated liver cells, are small accumulations of mononucleated hyaline cells and polymorphonuclear leucocytes (Plate XIV, fig. 12). Here plague bacilli are fairly numerous. The large hyaline cells, some of them possibly Kupffer's cells, appear to be undergoing division, but in some of the mononucleated cells the nucleus is dead and in haematein and van Gieson stained specimens the protoplasm of the cell has taken on one shade of yellow and the nucleus simply a deeper shade. The larger blood-vessels, both portal and hepatic veins, are filled with blood clots containing an enormous number of bacilli; many dead or dying leucocytes (as evidenced by their staining reaction) may be seen, along with a certain number of leucocytes which still retain their staining capacities. The branches of the hepatic artery also contain blood clots, but a smaller number of bacilli, many of them adherent to the lining endothelial cells, which may be detached, are usually granular and often vacuolated, and may no longer take on a nuclear stain. In the small bile ducts, the epithelium appears to separate from the underlying membrane rather more readily (? fluid present) than usual, and there is a curious opening up of the connective tissue spaces in the outer portion of the wall of the duct. Similar distension of the tissue spaces may be seen everywhere in the connective tissue. A finely granular cast, devoid of pigment, occupies the lumen in some of the bile ducts.

The capillary vessels are often separated by distinct spaces from the



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liver cells; in these spaces very few bacilli are found, though in the capillaries themselves the bacilli may be numerous. These spaces appear to result from oedema, an accumulation of fluid around the capillary and between it and the liver cell corresponding to the similar accumulation in the connective tissue of the wall of the bile duct and around the epithelium within the basement membrane of the bile duct. The coagulation of the blood within the vessels and the formation of ante-mortem clots correspond very closely to the similar conditions noted in the capillary vessels of the lung. Here again, the masses of bacilli are so dense that in an unstained preparation they appear almost like fibrinous clots embedded in the mass of red blood corpuscles, although there is little fibrin present.

In the second liver, in which the changes are less advanced, there is intense congestion throughout the whole capillary system, more marked, however, at one or two points; there is also imperfect staining of the liver cells, with great exaggeration of this feature in areas which are evidently minute necrosed patches, the result of an acute degeneration of a little area of liver cells; there is a slight increase of nuclei, principally of leucocytes, in some of the interlobular fissures and spaces.

In the portal vein are clots, some of which consist of masses of red blood corpuscles, others of homogeneous coagula in which are a few bacilli; in the margins of these coagula and still within the vessel are little groups of leucocytes, between and around which numerous bacilli may be seen. The endothelial cells of the large vessels are exceedingly granular, and at one or two points they appear to be proliferating; on them leucocytes accumulate in considerable numbers. The connective tissue fibrils beneath the endothelium are greatly swollen and between them leucocytes may be seen pushing their way. Here, as in the larger vessels of the lung, the bacilli are very numerous. In the hyaline-looking clots many "shadow" nuclei—nuclei very imperfectly stained—may be seen lying between the more pronouncedly stained nuclei. These shadow nuclei are swollen and vesicular and show but a slight trace of reticulum. In the congested capillaries, bacilli single or in small groups are present. In these same capillaries are "giant cells" which appear to result from proliferation and vacuolation of the nuclei of a series of endothelial cells, the protoplasm of which has run together to form a protoplasmic mass. Small accumulations of polymorphonuclear leucocytes and of lymphocytes with one or two large hyaline cells may also be found in the capillaries; indeed, taking the section as a whole, these stained leucocytes in the capillaries are

considerably more numerous than in a normal liver (Plate XIV, fig. 12). The lymph spaces in the connective tissue—which in this case is increased in amount, quite apart from the plague—are greatly dilated as though the tissue were oedematous, but there appears to be some recent proliferation of the cells lying between the bundles of collagenous fibrils. In the vessels of this connective tissue are a few bacilli, but they are by no means such a prominent feature as in the portal capillaries.

Special attention has been drawn to the small areas of badly stained degenerated liver tissue. Here the whole of the liver cells are imperfectly stained and even under a low power the tissues have a curious woolly look, have lost their sharp outlines and their nuclei stain badly. In these degenerating areas, contrary to what would be expected, the number of bacilli is small, only a few isolated organisms being found in some of the clots in the capillaries, although they may be exceedingly numerous in some of the capillaries in the immediate neighbourhood of the dead masses. Throughout the section the hepatic cells are in an advanced state of cloudy swelling; in many cases it is very difficult to make out the nucleus, and where present, it is swollen and vacuolated. There is no evidence of the presence of fat in the swollen granular cells, and as a rule no bacilli can be detected in the substance of the cell, though in some of the preparations there appears to be great dilatation of the sinusoids, whilst the bile capillaries are distended with a clear colourless fluid, and the central lumina of the capillaries stand out much more clearly than they do in a normal liver. Around some of the nuclei in the liver cells is a clear "court," formed by a series of vacuoles within the protoplasm arranged in a circle around the nucleus. This is certainly not due to recent fatty infiltration. Towards the periphery of the lobule the structure can be made out more easily than nearer the centre and here and there, along with the cloudy swelling, is distinct vacuolation of the cytoplasm of the hepatic cells corresponding apparently to the vacuolation seen in the parenchymatous cells of livers taken from cases succumbing to other *acute* infective fevers though this *may* indicate an earlier fatty infiltration of the liver cells. The granular and vacuolated structure of the liver cells, the disintegration by fragmentation and the imperfect staining of the nucleus, are very well brought out by the haematein and van Gieson stain, as is also the vacuolation of the nucleus; in some cells several vacuoles are seen, in others a single large vesicle with fragments of chromatin pushed to the periphery. The cytoplasm of many of these cells resembles a mass of foam



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(Plate XIV, fig. 12). One or two bacilli may be seen apparently invading the sinusoids, and even in the bile ducts, but this is not of frequent occurrence.

In the connective tissue in the portal spaces as in other new connective tissue, the oedematous condition is well marked, large clear spaces, in which few bacilli can be seen standing out very prominently. Here too and around the bile ducts there is a slight increase in the number of connective tissue nuclei. The capillaries are enormously dilated.

Where the epithelium usually lining the capillaries has been detached, bacilli appear to be adherent to a kind of basement membrane. The endothelial cells of the capillaries are often imperfectly stained, their nuclei are obscured and badly stained, their protoplasm cloudy and vacuolated. Sometimes, however, the endothelium still stands out very distinctly. Here again the hyaline clots appear to contain an enormous number of plague bacilli embedded in a clear homogeneous coagulum. In the immediate neighbourhood of these clots the red blood corpuscles run together, forming hyaline, orange yellow masses. The blood platelets and masses of red corpuscles in these hyaline clots undergo very considerable modification as regards their staining, and instead of an orange yellow they take on a distinct pink tinge, swollen and either single or in hyaline masses they form a very characteristic feature. They appear to have been acted upon directly by the fluids in which the bacilli are multiplying. In this case the multiplication may be post-mortem, as this liver has not been so well preserved as have most of the other specimens. No fibrin is to be seen in any part of the section. Many pairs of nuclei are seen in Kupffer's cells near the margin of the lobule, where there is a great accumulation of proliferating endothelial cells.

**SPLEEN.** There seems to be some little difference of opinion as to the changes that take place in the spleen. Childe<sup>5</sup>, for example, states that in the pneumonic form of plague, the spleen is less engorged and has fewer haemorrhages than the spleen taken from patients suffering from bubonic plague; whilst Flexner<sup>10</sup> Aoyama<sup>3</sup> and Wilm<sup>23</sup> all describe the spleen as being greatly enlarged, from two to five times the normal size, deeper red in colour, the pulp swollen, soft, hyperaemic and oedematous (Flexner). Sometimes, according to Wilm, the pulp may be harder than usual. Haemorrhages under the capsule and into the pulp tissue are described by Childe, Aoyama, Wilm, Lustig and Zardo<sup>17</sup>, and Strong, Crowell and Teague<sup>20, 21</sup>, who point out, further, that

the congestion is specially well marked at the immediate periphery of the lymphoid follicles. The Malpighian bodies are said to be affected differently in the two forms of plague. Flexner, Aoyama and Wilm describe them in the bubonic form as being enlarged or hyperplastic, both as regards endothelial and lymphoid cells, through multiplication of the cells of the lymphoid cords or follicles (Malpighian bodies), whilst Strong, Crowell and Teague maintain that in the pneumonic form these lymphoid follicles are for the "most part both relatively and absolutely small and seldom show any signs of proliferation." The latter observers say that the bacteria in these follicles are scarce and that, although there is swelling of the endothelial cells, there is little evidence of multiplication. Flexner describes hyaline changes in the walls of the arteries of the Malpighian bodies, and a cellular proliferation in the sub-intimal layers of the veins. He also describes leucocytes attached to the inner wall of the vessel, sometimes appearing to cause detachment of the endothelial cells; rarely is there any phagocytosis. Bacilli, he says, occur specially in the pulp, attaching themselves to the reticulum, and growing in irregular masses into the venous sinuses; they may occlude small blood-vessels and lymph spaces, and are so numerous and accompanied by so little reaction of the tissues that he is led to suggest that many of them have made their appearance after the death of the patient. Flexner, Yamagiwa<sup>25</sup>, Albrecht and Ghon<sup>1</sup>, Hamdi<sup>13</sup>, and Strong, Crowell and Teague all describe necrotic patches, the latter, who describe a small reddish-white infarct 4 mm. in diameter, associating this condition with the small haemorrhages that are here met with. Albrecht and Ghon, however, maintain that the source of the histological changes in these foci lies in the infiltrating cells, as, under their influence, necrosis of the wall of the capillary vessel takes place, often with a peculiar running together or coagulation of the tissue of the walls of the blood-vessel, of the blood and of the breaking-down cells in the immediate neighbourhood.

In our case the spleen was acutely congested, and the Malpighian bodies, though relatively smaller, were actually larger than normal. They stood out fairly distinctly from the deep red background of the pulp tissue. On microscopic examination, the fibrous trabeculae and the capsule are swollen and oedematous looking, clear spaces appearing in all the fibrous tissue. The central artery of each appears to occupy a greater area than usual (Plate XIII, fig. 10), apparently because of the great hyaline swelling of its walls, especially the intima, in which are large vacuoles. The endothelium lining the vessel is swollen, cloudy and somewhat imperfectly stained. Around, and in the immediate neighbourhood of these vessels, large open spaces, evidently filled with clear fluid, give the adventitia a very characteristic appearance. The reticulum of the adenoid tissue stands out very prominently,



its strands are swollen and the meshes of the network enlarged; the lymphocytes are numerous—more numerous than usual—but do not crowd or fill up the reticulum completely, and the whole tissue looks much more open than normal adenoid tissue. Few red blood corpuscles are seen in the vessels of the Malpighian body, except at its extreme margin. As soon as the pulp tissue is reached, however, the sinuses are seen to be enormously distended, and the usually delicate reticular framework of the pulp now stands out as thick hyaline or slightly granular bands lying between masses of red blood corpuscles. The sinuses, both arterial and venous, are greatly enlarged and filled with red blood corpuscles, a few detached endothelial cells, and a number of polymorphonuclear leucocytes. The endothelium lining the spaces is distinctly swollen, often vacuolated, and at points even proliferating. The nuclei of these endothelial cells stain imperfectly. Around the nucleus there may be little groups of vacuoles similar to those seen in other cells, the nucleus being cut off, except by very fine strands, from its cell protoplasm. The swollen strands of the reticulum appear to have absorbed a large amount of fluid. So-called giant cells (little more than a mass of cells, of which the protoplasm has run together, but not the nuclei) are seen. No fibrin can be made out in any part of the spleen.

There is pyknotic degeneration of the nuclei of some of the cells lying in the sinuses, especially where the bacilli are numerous. The walls of the smaller nutrient arteries are distinctly hyaline. In the central vessel of the Malpighian body the nuclei of the endothelial cells are very badly stained and distinctly vesiculated. Vacuoles appear in the connective tissue of the intima between the fibrils and in the nuclei of the cells, but here no plague bacilli are seen. Many of the lymphoid cells lying in the reticular spaces of the Malpighian body contain vacuoles. As we come near the margin of the adenoid sheath, a few bacilli are found; and then in the pulp an enormous number of plague bacilli may be seen lying on the swollen trabeculae, especially when the sinuses are reached. Here a number of bacilli are seen lying free, sometimes in a hyaline-looking material similar to that seen in the blood-vessels of the liver and lung but now and again isolated. Here also some of the red blood corpuscles appear to be so altered that they take on a pink tinge; this, however, is not nearly so marked as in the intravascular coagula in the liver. Small areas of badly stained tissue—focal necroses—appear wherever large numbers of bacilli are concentrated, but how far this is a post-mortem condition it is difficult to say.

The most interesting features presented are the swelling and vacuolation of many of the endothelial cells in the sinuses, the bacilli making their way from the lumina of the larger vessels into a softened swollen intima, in which there appears to be cell proliferation and infiltration with polymorphonuclear leucocytes, and the pyknotic changes where the bacilli are numerous; the invasion of endothelial cells by large numbers of bacilli, the strings of bacilli adherent to the walls of the sinuses where the epithelium has been detached; and the pyknosis and extreme vacuolation of these separated cells.

In addition to these, large marrow-like giant cells which do not take up other cells or bacilli, others, several times the size, which appear to have ingested degenerated leucocytes but no red cells, may be found in the clots in the sinuses. Some of these also contain bacilli.

In the small Malpighian bodies the bacilli appear to be more numerous, especially where the blood-vessels and capillaries are dilated, but they are never so numerous as in the pulp tissue.

**KIDNEY.** Childe<sup>5</sup>, reporting on cases of pneumonic plague, mentions that the kidney, like other organs, resembles the corresponding organ taken from cases of the bubonic form, "except that the general engorgement and haemorrhage are less marked"; that large haemorrhages are usually absent, but that engorgement and petechiae may be found in the pelvis of the organ; that it is enlarged, the capsule stripping off easily and showing petechial haemorrhages in the pale, soft, degenerated parenchymatous tissue beneath. The venae stellatae are very visible (Aoyama<sup>3</sup>). The cortex appears to be somewhat thickened (Aoyama, Wilm<sup>23</sup>). Strong, Crowell and Teague<sup>20, 21</sup> describe the outer surface of the kidney after removal of the capsule as presenting a red granite-like appearance due to the standing out of the deeply injected vessels against the pale grey or yellowish parenchyma of the organ. They also mention that "the glomeruli were frequently swollen and often appeared as fine, reddish, pin-point-size areas. Petechiae were frequently seen in the pelvis and upper portion of the ureters." Although this is not explicitly stated, these observers evidently noted swelling of the cortex.

Most observers seem to agree that after congestion, cloudy swelling of the epithelium of the convoluted tubules is by far the most common histological feature presented in the kidney. Some cloudy swelling of the epithelium in the straight tubules is also described. Fatty degeneration also occurs—Aoyama, Wilm, Strong, Crowell and Teague, and Fujinami<sup>11</sup>. Hamdi<sup>13</sup> describes the contents of the urinary tubules as "mostly a reticular coagulated mass and hyaline cylinders," resulting from breaking up of the protoplasm of the degenerated cells. The nuclei in these cells stain very imperfectly (Aoyama, and those who



describe cloudy swelling). Yamagiwa<sup>25</sup> mentions that the lumina of many of the urinary tubules are plugged with granulated cylinders, but Aoyama and Hamdi describe hyaline cylinders in this position, and Strong, Crowell and Teague a coagulated fluid exudate or transudate, as being of not infrequent occurrence. Unchanged blood or red blood corpuscles are also said to be present in the urinary tubules, often accompanied by clumps of bacilli. Most of those who have made careful examination of the kidneys in these cases of pneumonic plague, describe changes in the glomeruli, and it is evident that both in bubonic and pneumonic plague the alterations are due to a secondary septicaemia, rather than to any peculiarity of the type of plague that is under consideration. Engorgement of the vessels of the glomeruli is always present; and apparently coagulation of the blood, accompanied, possibly, by a coagulative necrosis of the cellular walls of these vessels, takes place, this corresponding to the condition of cloudy swelling or granular degeneration met with in the epithelium of the convoluted tubules. This coagulation of the blood is specially insisted upon by Aoyama and Albrecht and Ghon<sup>1</sup>, who mention that the coils of the glomeruli may, in places, be homogeneous, vitreous, and dilated; and that they may be transformed into bands, which consist of trabeculae or thread-like coagulations,—indeed, they describe a coagulation not only of the tissues, but of the fluids of the tissues, and of the vessel elements themselves. Aoyama describes a multiplication of the nuclei of the glomeruli, but Strong, Crowell and Teague pass over this and insist rather on the degeneration of the epithelium covering the glomerular tufts, following Aoyama in so far that they describe a fluid exudate as present in Bowman's capsule and also in stating that this space is often filled with desquamated cells or with a granular exuded mass. Strong, Crowell and Teague are the only observers who confirm Herzog<sup>13a</sup> in describing fibrin thrombi as occurring in the glomeruli. Hamdi states that the changes in the interstitial tissue of the kidney are slight, but Aoyama, and Strong, Crowell and Teague mention a separation of the connective tissue fibres and put it down to an oedematous condition. The vessels in this interstitial tissue are described by them as "greatly dilated." All observers who mention the bacilli at all, describe them as present in the interstitial tissue, in the glomerular vessels and in both convoluted and straight tubules, especially in the latter, where the amount of blood is usually greater than in the convoluted tubules.

We found the capsule of the kidney slightly thickened, apparently the result of separation of the laminae by oedematous fluid. The walls of the arterioles are somewhat thickened and hyaline, many of them are distended with clot, made up partly of red blood corpuscles, partly of the same hyaline material seen in the vessels of other organs; the intima is thickened and hyaline. The Malpighian bodies (Plate XV, fig. 15) are considerably enlarged, owing (1) to congestion of the capillary loops, and (2) to a thickening of the walls of these vessels



and of the tissue between them, in which there seems to be some slight increase in the number of nuclei. Even with a low magnification, a homogeneous looking exudate, partially filling the space between the glomerular tuft and Bowman's capsule, is seen in some of the Malpighian bodies. Throughout the section, the basement membrane of Bowman's capsule is swollen and looks as though it had absorbed fluid; the well-preserved endothelial lining of the capsule composed of an almost continuous layer of swollen cells has separated from the swollen capsule.

The nuclei lining Bowman's capsule are very distinctly stained and appear in some cases to be undergoing division, as do also similar cells covering the capillary loops. In the capillaries in the tuft a few bacilli may be seen adherent to the endothelial wall (Plate XV, fig. 15). The clot in the large vessels consists of a granular mass, in which may be seen colourless shadows of red blood corpuscles. Examining one of the clots carefully, a large mononuclear leucocyte with imperfectly stained nucleus and a large vacuole in the protoplasm may be seen in the centre and scattered through it are some half dozen isolated bacilli. In the intertubular capillaries the congestion is very marked. The endothelial cells lining these capillaries are often swollen and vacuolated, and the basement membrane thickened and prominent. In the finer capillaries, groups of bacilli may be seen, usually adherent to the endothelial wall. In the capillary loops, owing to the swelling of the basement membrane, the intima has a much coarser appearance than in the normal Malpighian body. Wherever there is exudation in the Malpighian body, the cells lining Bowman's capsule show a large nucleus, and the cytoplasm is granular and swollen (Plate XV, fig. 15). The nuclei of a few of these cells take on no nuclear stain; they are of the same tint as the cell protoplasm. The changes in the epithelium of the convoluted tubules are very characteristic. In a few tubules, there is simply enormous enlargement and great granularity of the cytoplasm of the large epithelial cells; in others the granular protoplasm is distinctly vacuolated (Plate XV, fig. 16); in others again there appears to be little more than a network of granular protoplasm, with, here and there, a nucleus more or less altered, whilst in some of the tubes there are simply a few granules and a few nuclei to which are attached minute portions of cell protoplasm. All this results apparently from the extreme swelling and vacuolation of the cells, followed by rapid disintegration of the cytoplasm. Although the bacilli are fairly numerous immediately under the basement membrane of these tubes—



that is, in the capillaries—we were unable to find any bacilli in the tubules in which this rapid and extreme disintegration was going on. Careful search was made for the presence of red blood corpuscles in these convoluted tubules, but none were observed; they certainly cannot be numerous even in the lower part of the collecting tubules. In the looped tubules of Henle, the more or less cubical epithelium is but little altered. In the collecting tubules there is cloudy swelling of the cubical epithelial cells, or even some disintegration of the protoplasm. In these tubules, too, are little collections of granular golden-brown pigment, which can only be derived from red blood corpuscles. Here again there is marked swelling of the basement membranes of the tubules, whilst the nucleus of the epithelium is, in a large number of cells, almost surrounded by a free space, though very delicate threads may be seen passing from the margin of the nucleus to what looks like a delicate cell wall. These are evidently “dropsical” cells which ultimately break down, and only a few granules and the free nucleus above described remain. In the lower part of some of the tubes, the nuclei with small fragments of cytoplasm attached, have accumulated and formed casts which might easily be taken for giant cells, but they are distinctly within the tubes. The degeneration of the endothelial cells lining Bowman’s capsule appears to take the form of great enlargement, cloudy swelling of the protoplasm, and impaired staining of the nucleus. Even in some of the connective tissue cells in the glomerular tuft, vacuolation is observed around the nuclei of the connective tissue or endothelial cells. It is rather extraordinary that with such intense congestion there should be so little evidence of haemorrhage into the tubules. Here and there hyaline casts may be seen. In one or two of the medium-sized veins, as in the veins of other organs, one has an almost pure culture of the plague bacillus.

#### GENERAL REMARKS.

The histology of these specimens appears to us to be of special interest in that it affords evidence of the presence of an extremely acute septicaemic condition. The heart, with the vitreous condition of the muscle and the comparatively slight degree of cellular proliferation, has evidently been affected by very active toxins. In the liver, we have typical examples of the lesions produced by specific infective micro-organisms that give rise to toxic substances; the swelling of the parenchymal cells, the cloudy swelling, the vacuolation, the rapid



disintegration of the cytoplasm, the vesiculation of the nuclei and the hyaline swelling of basement membranes all pointing in the same direction. The epithelium of the kidney, granular, vacuolated and disintegrated, and with its altered nuclei, is modified by a similar toxic activity, the toxin being excreted by the epithelial cells and in a lesser degree in the fluids that pass out from the capillaries of the glomerular tuft into the capsule. All the basement membranes are swollen. In the spleen, the principal changes are in the walls of the central artery of the Malpighian body, in the reticulum of the highly-developed adenoid sheaths of this vessel, and in the lining endothelium and basement membranes of the splenic sinuses. In all these positions, rapid and marked changes have taken place, such as would in any other infective disease at once be ascribed to a septicaemic condition.

In the lungs, the lesions are far less marked than one would expect, were the pneumonia the main or most important factor in the disease. It is obvious, of course, that the pneumonia is lobular in type and that it differs very materially from the pneumonia set up by the *Diplococcus pneumoniae* which was never found in any section stained by Gram's method. The greater part of the lung tissue is oedematous, a condition which, from the histology and from the symptoms as described by those who examined the patients in the epidemic during which these specimens were collected, appears to have arisen at a later date than the catarrhal pneumonia, though this may not apply to the bronchitis, a characteristic feature in the case under examination. It would, of course, be foolish to found any general argument on observations made on one or two cases, but it appears to us that here at any rate there has been an acute bronchitis, induced, perhaps, by a large dose of the plague bacillus, and that along with this, there has been some collapse and catarrhal pneumonia, especially as in the immediate neighbourhood of the collapsed and catarrhal patches, some of the alveoli are distended and emphysematous. From these catarrhal pneumonic patches, the *Bacillus pestis*, the exciting cause of this local disease, has passed into the lymphatics and so to the capillaries in the alveolar walls, and a septicaemic condition has been set up. Following this, the bacilli have been inhaled from the bronchial tubes into other alveoli, and there multiplying, have not set up any cellular reaction, but have induced a marked oedema, the bacilli with their poison in the circulating blood counter-acting the positive chemiotaxis and cell reaction that would otherwise have occurred in the air vesicles. We have, in fact, a repetition of the conditions met with in malignant oedema, when the malignant oedema



bacillus is injected both into the muscle substance and into the vein. This, we think, accounts, in the case under review, at any rate, for the lack of coagulated fibrinous lymph, not only on the surface of the lung, but also in the alveolar spaces; it also accounts for the lack of fibrin in the other organs, the septicaemic condition interfering with the passage of leucocytes from the vessels. The exudate resembles that of passive oedema rather than that of an acute inflammatory exudation.

Our investigations seem to us to point to the suggestion that in the Manchurian outbreak the amount of the infective material gaining access to the upper respiratory passages, to the tonsils, fauces, etc., is of prime importance in determining the character of the septicaemia—for we are satisfied that this is a septicaemia or bacteraemia resulting from a pulmonary infection. In warm countries where the people live in the open and where the facilities and channels by which infection is communicated appear to be those provided by rats and fleas, and where the plague material is carried more or less directly from one patient to another, or from the rat, by the flea; to the human subject, the local reaction of the tissues and the bubo may prevent the extension of the bacteria, especially if the dose be small and the septicaemic condition occurs at a comparatively late stage; whilst if there is good reaction of resisting tissues, the disease may never become septicaemic. If, however, the septicaemia once develops, it is evident that the internal organs are affected much as in the pneumonic form of plague. In Manchuria, where plague was at its height in the depth of winter, the facilities for the inhalation or ingestion of large numbers of plague bacilli were far greater than they can possibly be in warm countries where people live "in the open." The patients, residing in badly ventilated houses, closed because of the intense cold, and heated artificially, are living in highly infected incubators of the most approved kind. Septicaemias are rapidly developed, and although the lung might in a certain proportion of cases be the primary seat of infection, the late lung symptoms—smaller or larger areas of dulness, râles, only shortly before death (if coarse râles are heard it is looked upon as evidence that the patient is not suffering from pneumonic plague), oedema, bacilli in large numbers in the sputum—observed seem to point to the occurrence of a secondary pneumonia in a certain proportion of the cases examined clinically. To explain the differences of opinion as to the importance and meaning of certain histological findings is difficult, though it may be suggested that the pleuro-pneumonia with a fibrinous lymph observed in certain cases may indicate the presence of a primary pneumonia in which there has

been a massive infection by massive doses, whilst the catarrhal pneumonia with bronchitis followed by oedema appears to suggest a pneumonic condition following a septicaemia. Should we be able to obtain more material for examination, we hope to return to this question.

Although it is probable that the *Bacillus pestis* multiplies in various sites, but especially in the vessels, after death, and even whilst the patient is dying, it is evident that during life there must be an enormous multiplication to produce such a virulent septicaemia as that indicated by the lesions observed. We cannot but feel that during the earlier stages of the disease the tissues and fluids of most patients must exert a very active bactericidal action, and that the disease was so intensely fatal in the Manchurian epidemic and the patients succumbed because the dose of infective material was always massive and entered by ever open and slightly resistant portals. It may very well be that during an epidemic of bubonic plague a considerable number of patients may be actively immunised by small doses of bacilli introduced by bruises or punctured wounds, however made and infected. This, we think, must account for the sharp line of demarcation, as regards susceptibility, that exists between patients living under conditions unfavourable to massive infection and those living under conditions in which they are exposed more or less continuously to massive doses of the infective agent. It would appear that when the massive dose has been taken, the prognosis is bad, unless in the meantime there has been some reaction of the tissues as a result of which an active immunity has been gradually developed. In the case of the bubonic plague, the advance of the bacillus is so interfered with that not only a local, but a general immunity may be acquired before the bacilli can reach the blood in any considerable numbers, whilst in the case of infections by the lungs or naso-pharyngeal regions, the local reaction and resistance being comparatively slight and the dose of infective material large, the septicaemic condition is very rapidly produced, in many cases before there has been time for the development of any but the earlier typical changes associated with pneumonia.

We wish here to thank Mr H. R. Gillings for the care with which he has made the drawings accompanying this article, Mr E. E. Stubbings for the preparation of a number of the specimens and Mr F. G. Binnie and Miss Evelyn G. Fox for help in checking references to literature and in getting the paper through the press.



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## ERRATA.

Plates XII to XV, which along with the article are reprinted from the *Journal of Pathology and Bacteriology*, are incorrectly numbered, and in referring to them the following correction table must be used.

Plate XII, fig. 1=	Plate XIV, fig. 10
„ „ „ 2=	„ „ „ 9
„ „ „ 3=	„ „ „ 11
„ „ „ 4=	„ XV, „ 13
„ XIII, „ 5=	„ XIV, „ 12
„ „ „ 6=	„ XV, „ 14
„ „ „ 7=	„ „ „ 16
„ „ „ 8=	„ XII, „ 5
„ „ „ 9=	„ XV, „ 15
„ „ „ 10=	„ XII, „ 3
„ XIV, „ 11=	„ „ „ 4
„ „ „ 12=	„ XIII, „ 8
„ „ „ 13=	„ „ „ 7
„ „ „ 14=	„ „ „ 6
„ XV, „ 15=	„ XII, „ 1
„ „ „ 16=	„ „ „ 2

DESCRIPTION OF PLATES XII TO XV.

PLATE XII.

All these sections are stained with Giemsa's stain.

Fig. 1. Section of lung. ( $\times 300$ .)

- a. Collapsed alveolar space.
- b. Swollen basement membrane which looks as though it had absorbed fluid.
- c. Large epithelial cell containing ingested plague bacilli and carbon pigment.
- d. Congested and dilated capillary.
- e. Air vessels distended with coagulated albuminous fluid.
- f. Plague bacilli at periphery of alveolus in which is coagulated albuminous fluid.
- g. Thickened capillary wall.

Fig. 2. Section of bronchial mucous membrane and submucous tissue. ( $\times 90$ .)

- a. Swollen basement membrane.
- b. Peg-top shaped and rounded cells resulting from rapid proliferation.
- c. Dilated vessels.
- d. Oedematous connective tissue.

Fig. 3. Section of lung. ( $\times 1000$ .)

- a. Large mononuclear hyaline cell containing ingested plague bacilli.
- b. Red blood corpuscles in congested capillary.
- c. Swollen basement membrane.
- d. Plague bacilli adhering to swollen basement membrane from which epithelium has become detached.

Fig. 4. Section of blood vessel. ( $\times 1000$ .)

- a. Swollen intimal fibrils with interfibrillar spaces.
- b. Muscular coat.
- c. Proliferating endothelial cell (?).
- d. Large hyaline cell with ingested bacilli and vesicular nucleus.
- e. Red blood corpuscles.
- f. Large hyaline cell.
- g. Polymorphonuclear leucocyte.

PLATE XIII.

Fig. 5. Section of lung stained with haematein and van Gieson's stain. ( $\times 350$ .)

- a. Homogeneous coagulated albuminous fluid in which are
- b. Spaces.
- c. Phagocytic hyaline mononuclear cell containing carbon pigment.
- d. Congested blood vessel with swollen and hyaline basement membrane and carbon pigment in surrounding lymph space.
- e. Similar pigment in larger lymph space.
- f. Nucleus of endothelial cell.
- g. Polymorphonuclear leucocyte.

Fig. 6. Section of heart muscle stained with haematein and van Gieson's stain. ( $\times 100$ .)

- a. Oedematous epicardial connective tissue.
- b. The yellow tissue beneath this appears to consist of altered muscle and connective tissue in which there is some nuclear proliferation.



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- c.* Muscle bundles in a state of cloudy swelling.
- d.* Hyaline muscle in which large fractured vitreous blocks may be seen.
- e.* Distinct transverse fragmentation of the swollen muscle fibres.

Fig. 7. Section of heart muscle stained with haematein and van Gieson's stain. ( $\times 350$ .)

- a.* Proliferating interfascicular cells, some degenerating with badly staining pyknotic nuclei. (In original drawing the nuclei vary much more than in the reproduction.) There is evidently a great accumulation of fluid in these spaces.
- b.* Site of capillary vessel.
- cd.* Cloudy and vitreous swelling of muscle fibres.
- e.* Capillary vessel with swollen endothelial lining.

Fig. 8. Section of heart muscle stained with haematein and van Gieson stain. ( $\times 1000$ .)

- a, a.* Normal muscle fibre.
- b.* Cloudy and hyaline or vitreous swelling.
- c, d.* Fractured "vitreous" fibres.

Fig. 9. Section of liver stained with Giemsa's stain. ( $\times 1000$ .)

- a.* Granular, vacuolated and disintegrating liver cells.
- b.* Phagocyte containing plague bacilli in portal capillary. ? Kupffer's cell.
- cd.* Bacilli lying free in portal capillary.
- e.* Polymorphonuclear leucocyte.

Fig. 10. Section of spleen stained with Giemsa's stain. ( $\times 200$ .)

- a.* Central vessel of Malpighian corpuscle, swollen fibrillar tissue with interfibrillar spaces (? filled with fluid).
- b.* Endothelial cell, imperfectly stained.
- c.* Swollen and vacuolated lymphocyte.
- d.* Swollen trabeculae between small sinuses at margin of corpuscle. To these numerous plague bacilli are adherent.
- e.* Arterial sinuses filled with red blood corpuscles.
- f.* Swollen trabeculae on which lie enormous numbers of bacilli.
- g.* Badly stained nucleus of (?) endothelial cell.

### PLATE XIV.

All these sections are stained with haematein and van Gieson's stain.

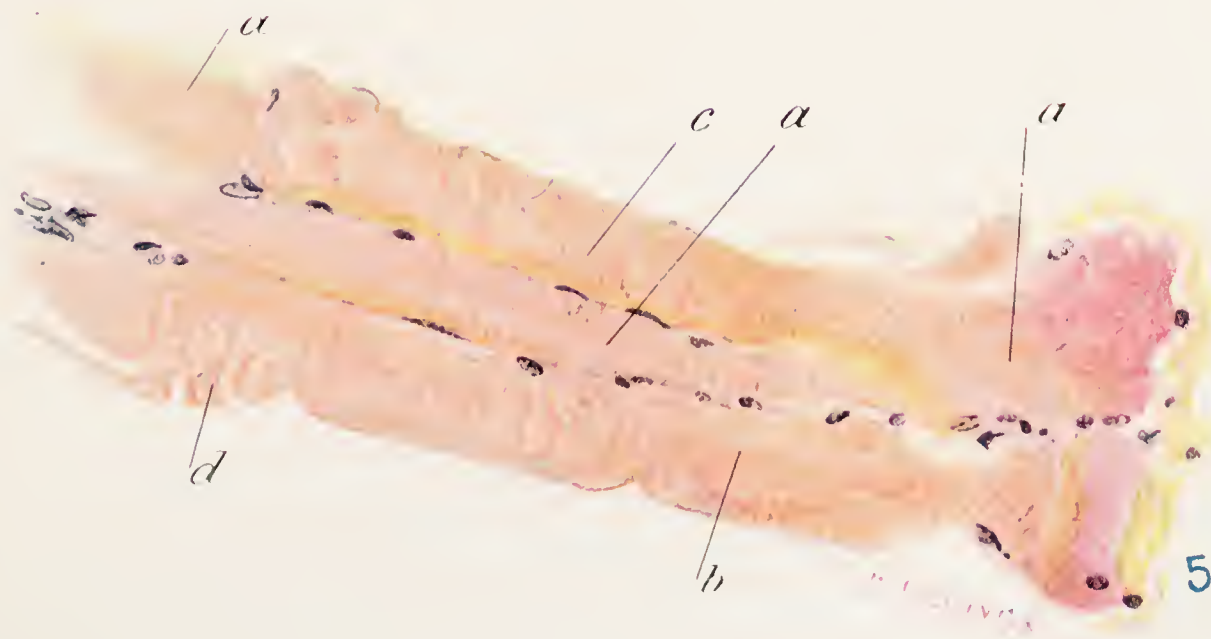
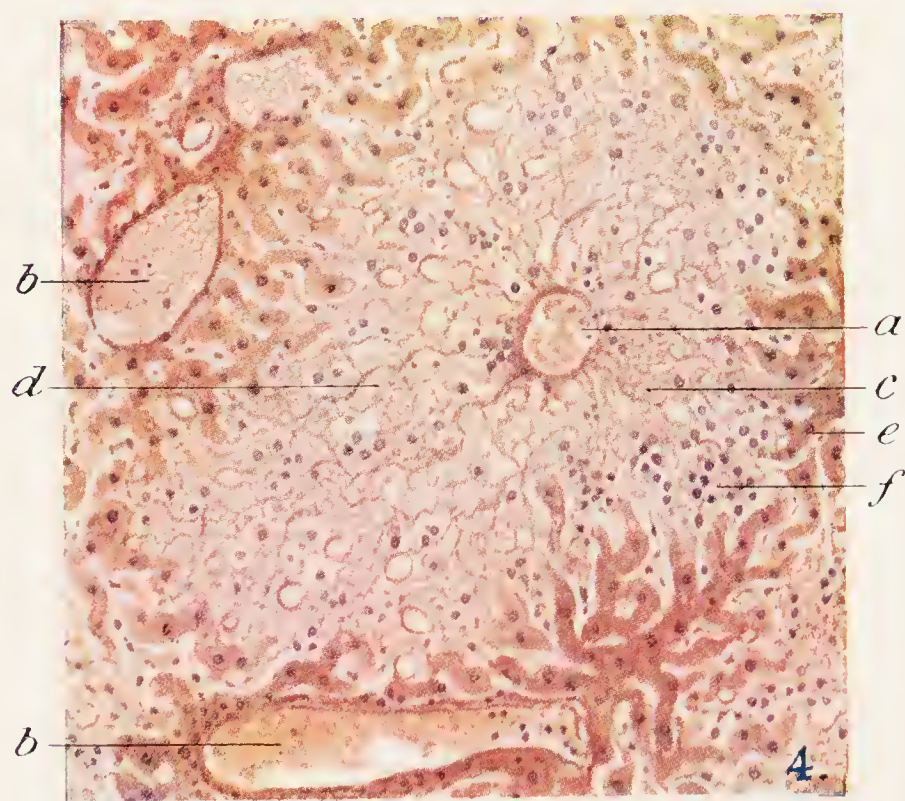
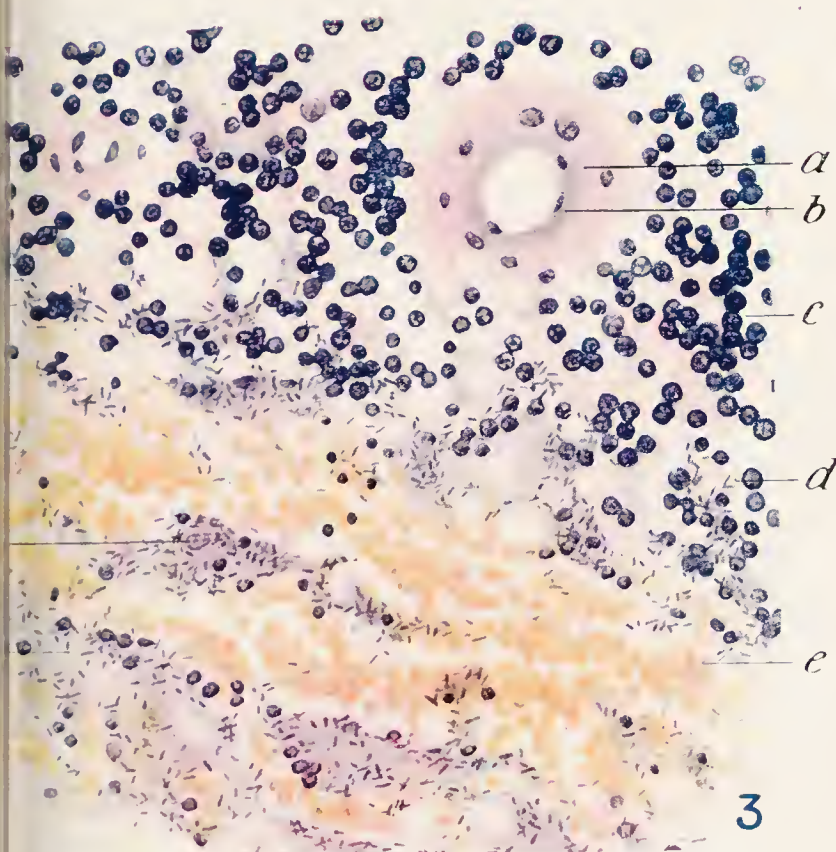
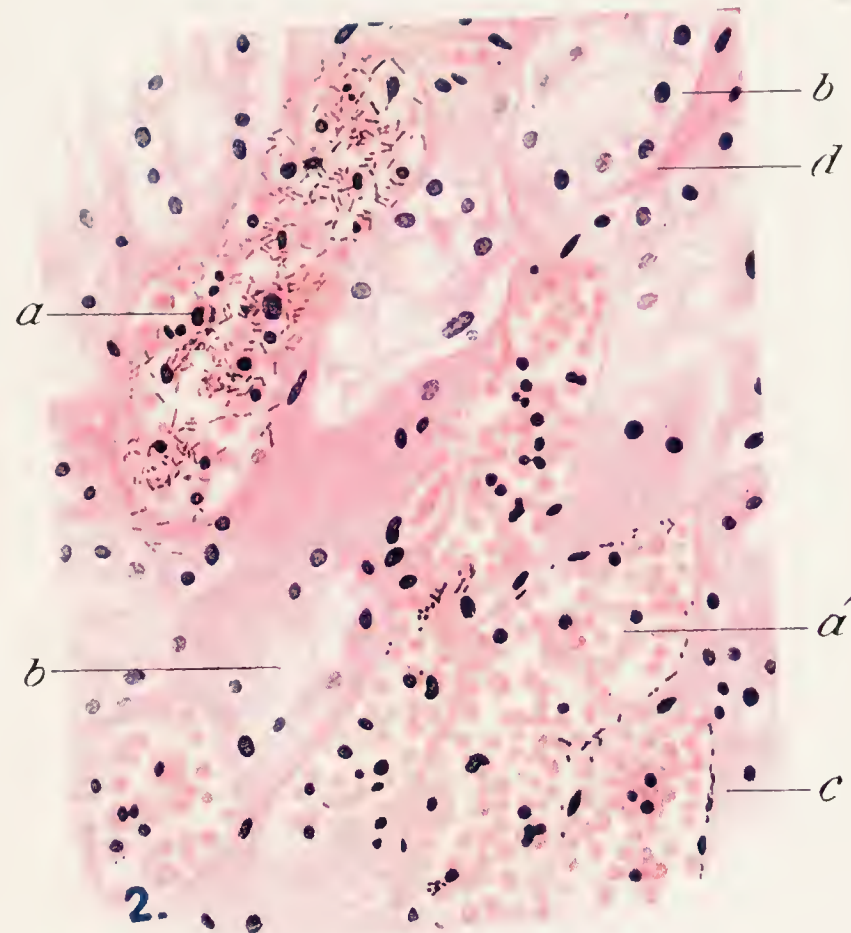
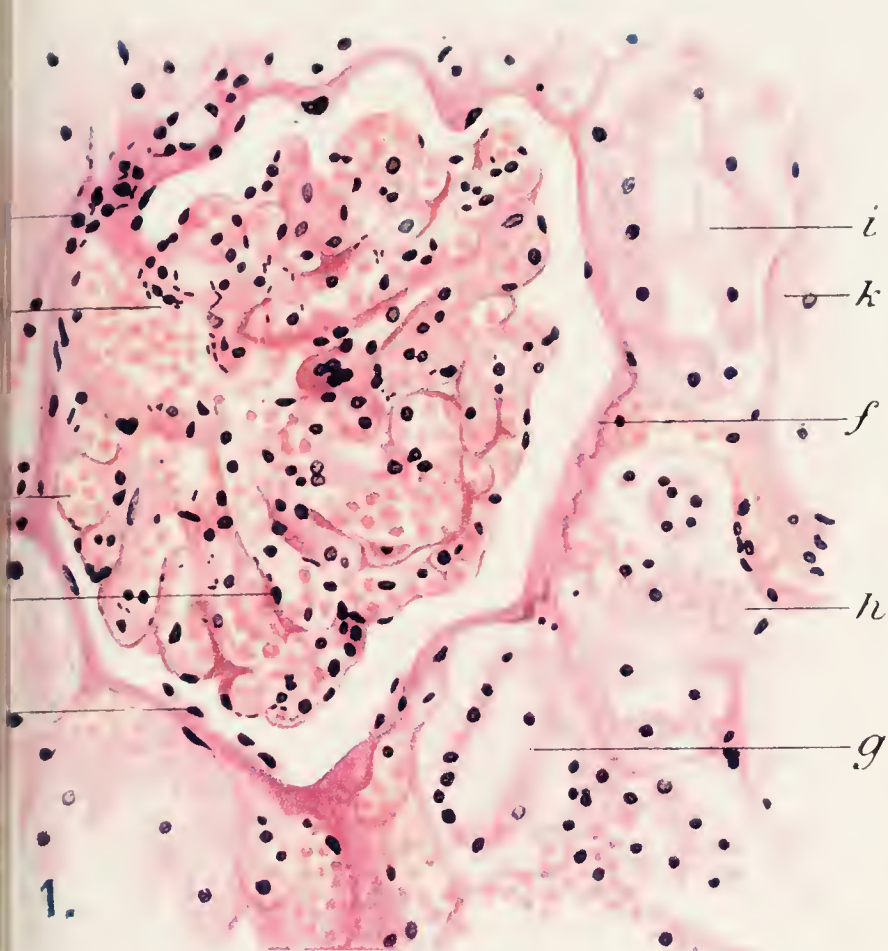
Fig. 11. Section of liver. ( $\times 80$ .)

- a.* Central vein.
- b.* Portal vein.
- c.* Granular *débris* of liver cells in central and intermediate zones of the lobule lying between *d*, swollen basement membranes and capillary walls.
- e.* Liver cells at the periphery of the lobule in a condition of cloudy swelling and vacuolation.
- f.* Increased number of polymorphonuclear leucocytes.

Fig. 12. Same section. ( $\times 300$ .)

- a.* Periphery of the lobule: liver cells swollen, cloudy and vacuolated.
- b.* Disintegrating liver cells in the intermediate zone.
- c.* Swollen capillary wall.
- d.* Mass of plague bacilli.
- e, e.* Groups of polymorphonuclear leucocytes.
- f.* Swollen capillary walls near the centre of the lobule.
- g.* Red blood corpuscles.
- h.* Proliferating endothelial cells. Kupffer's cells.

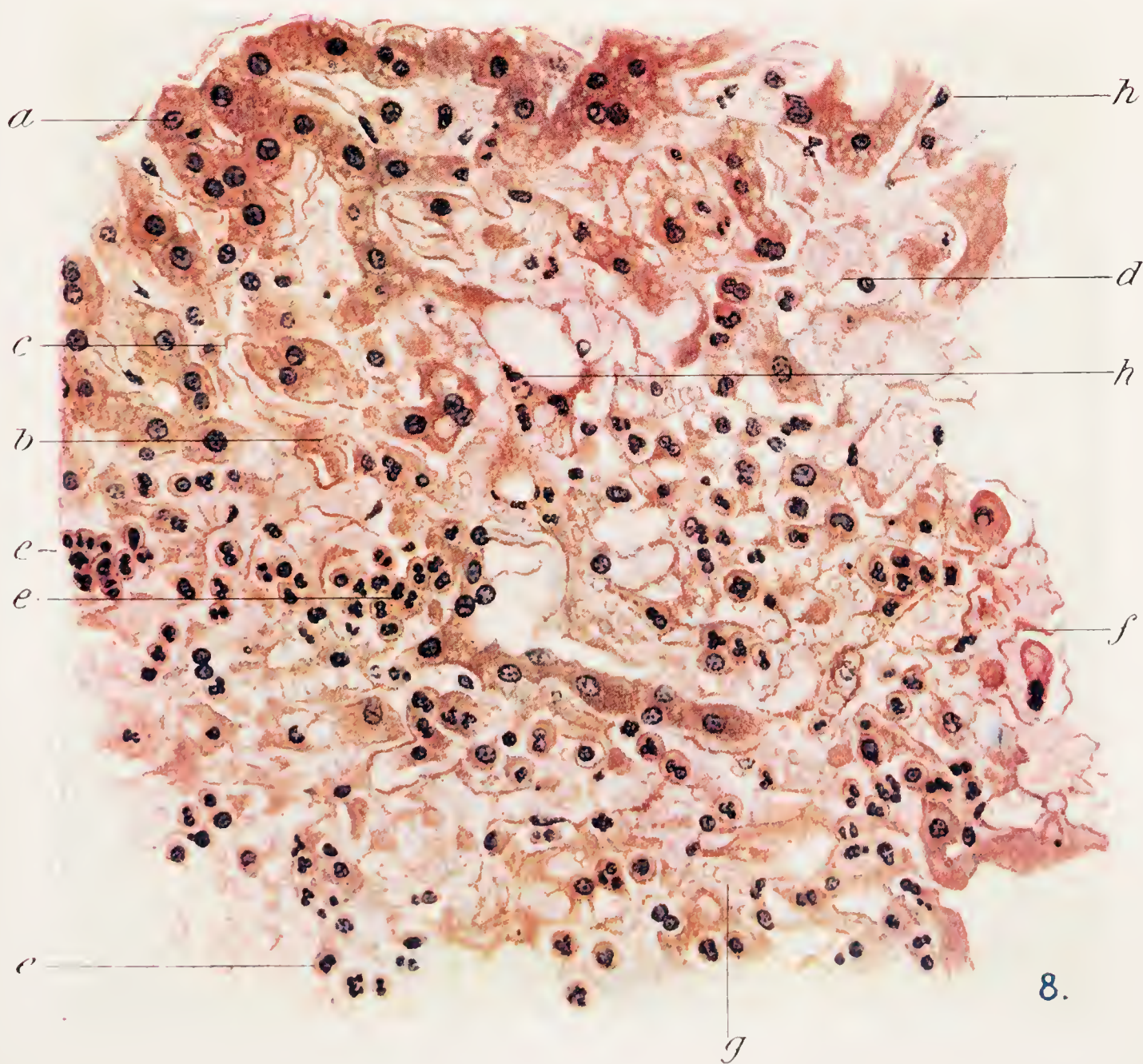
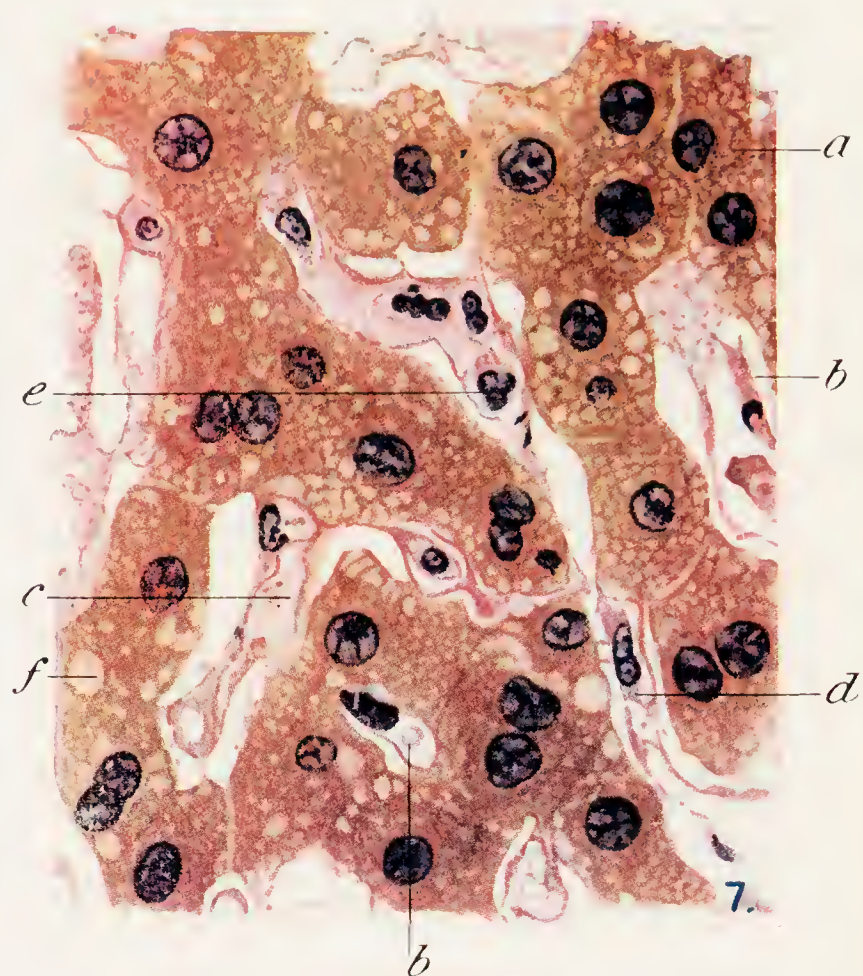
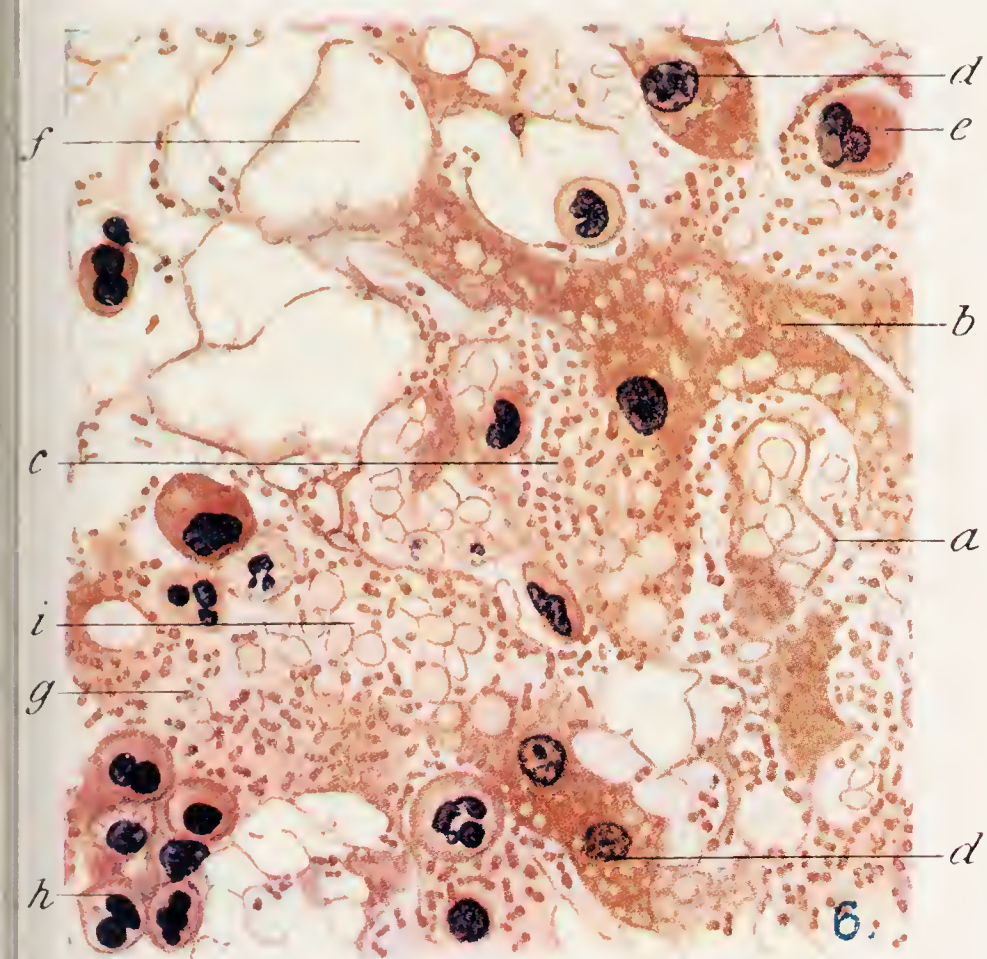




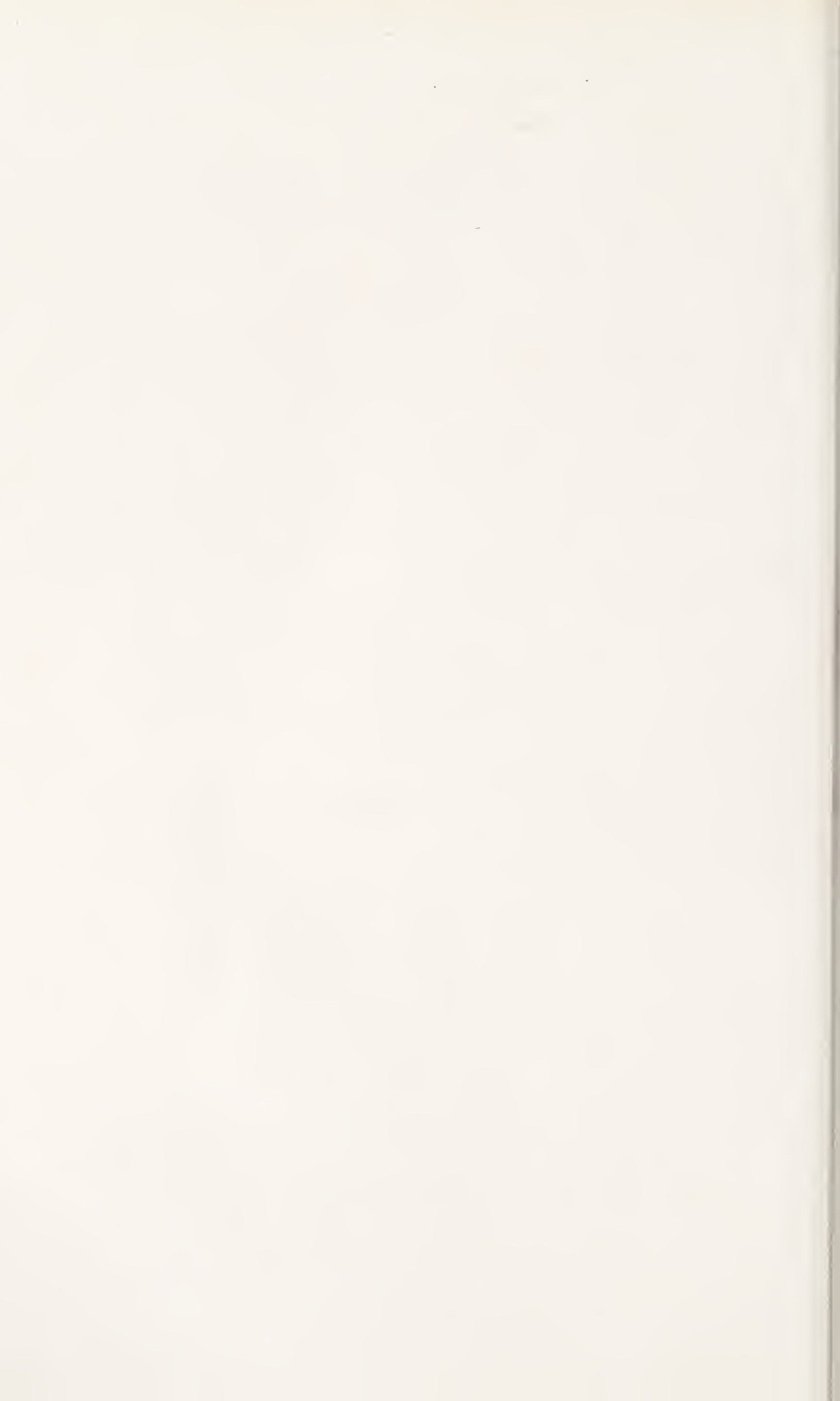


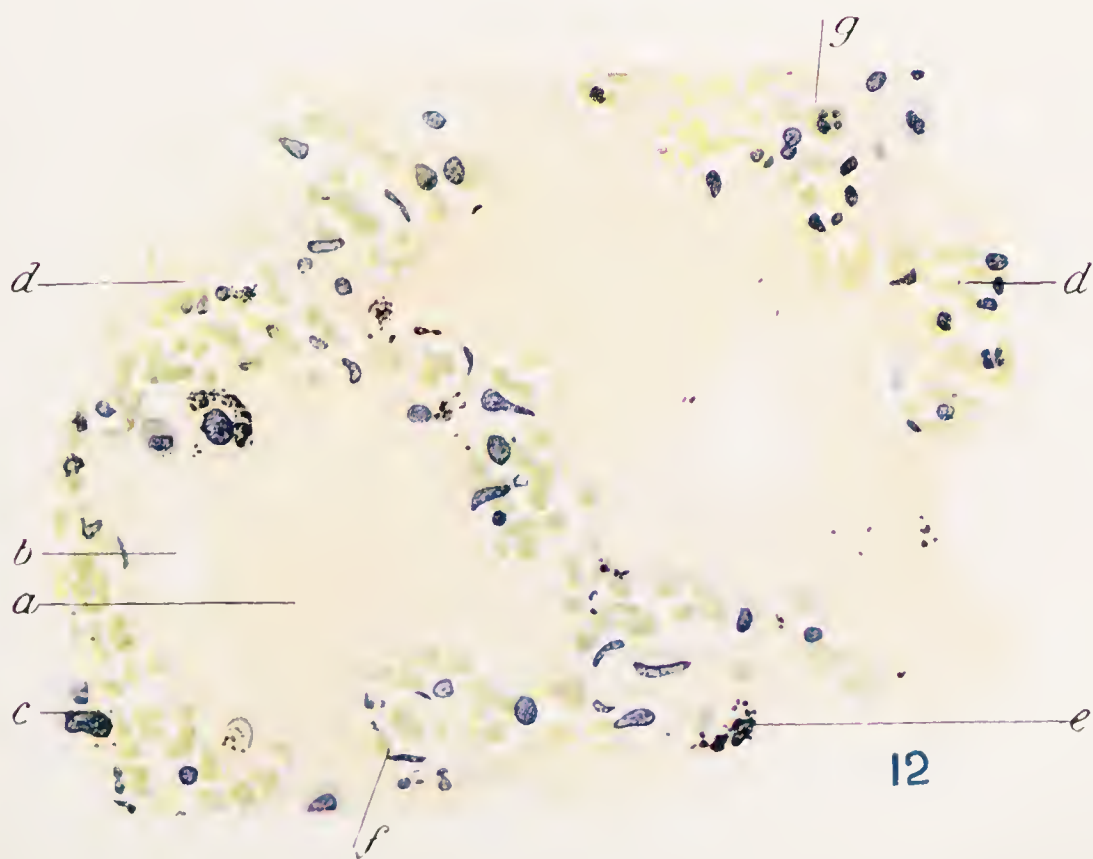
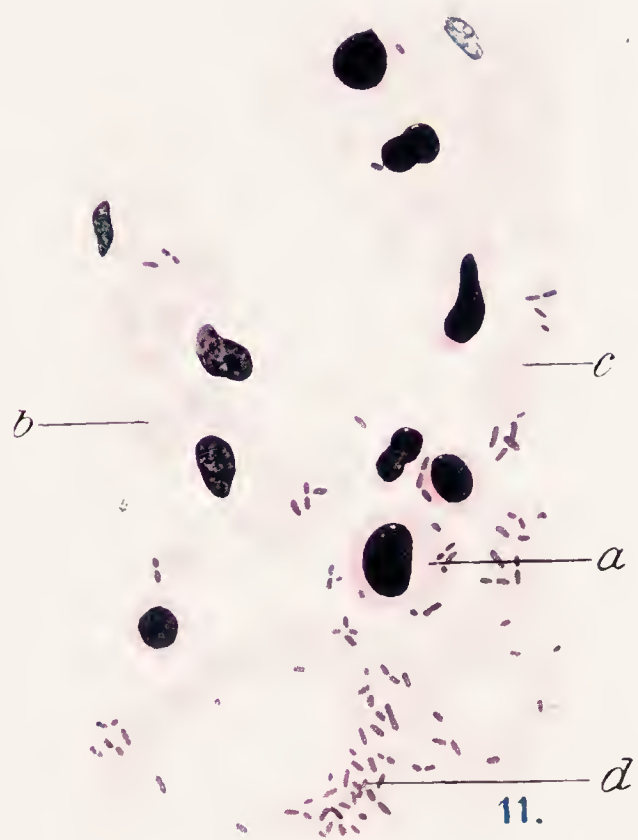
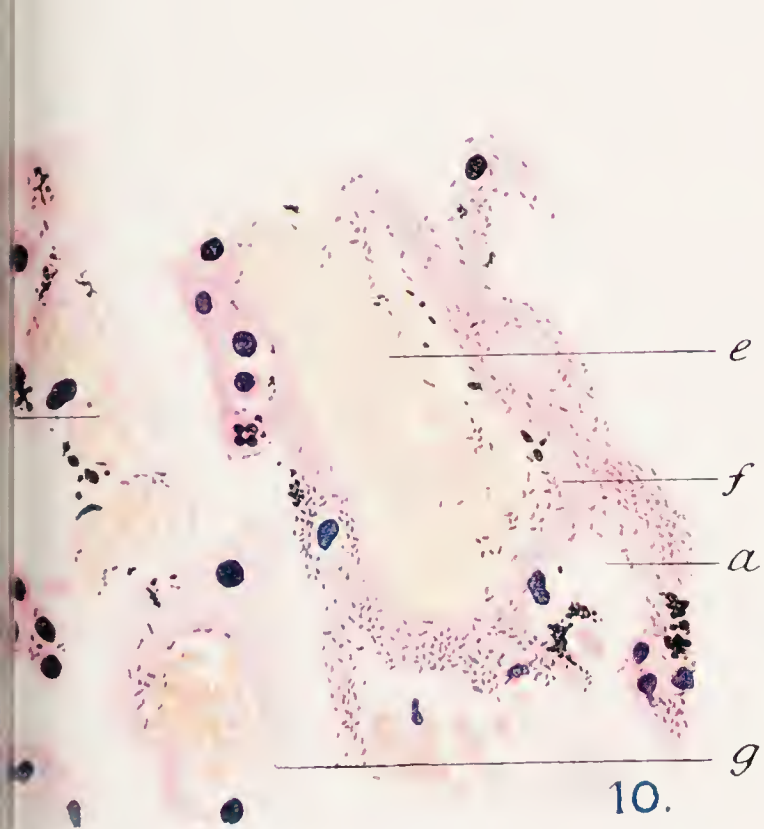
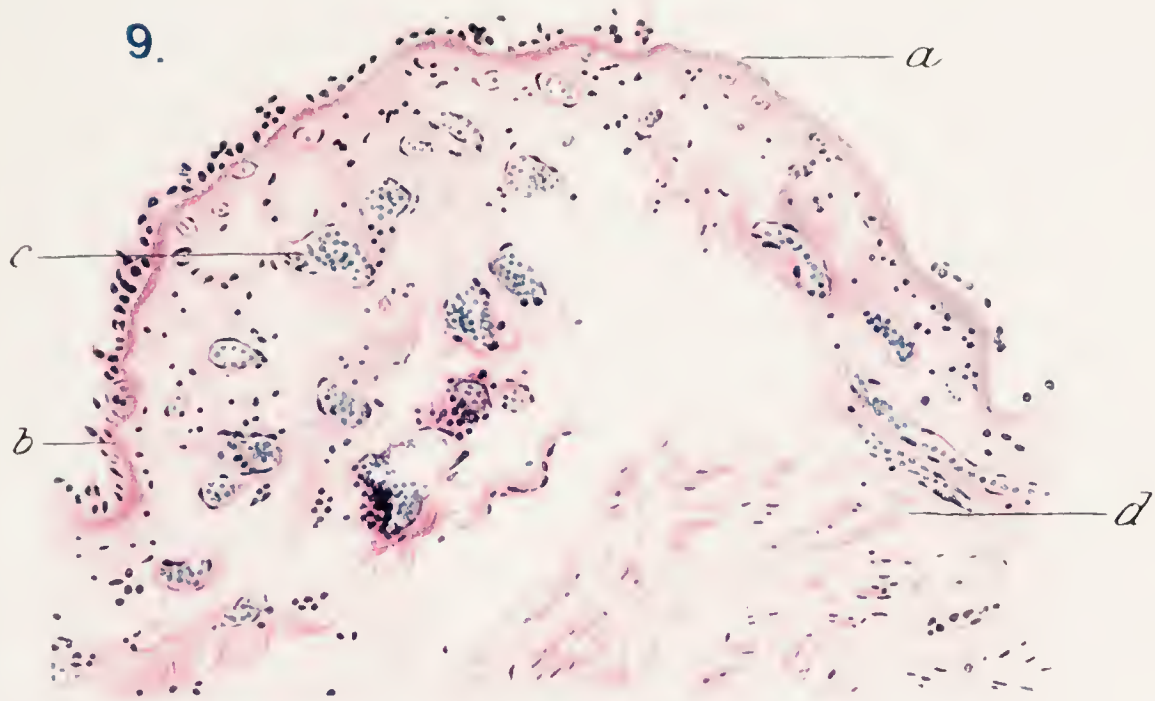
















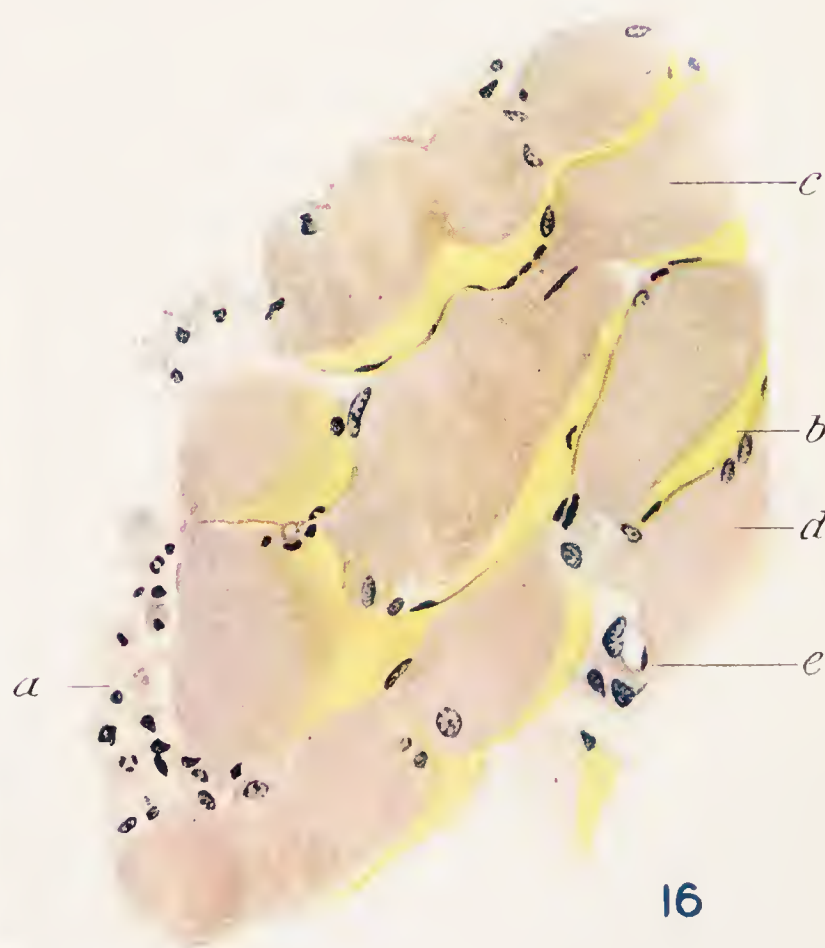
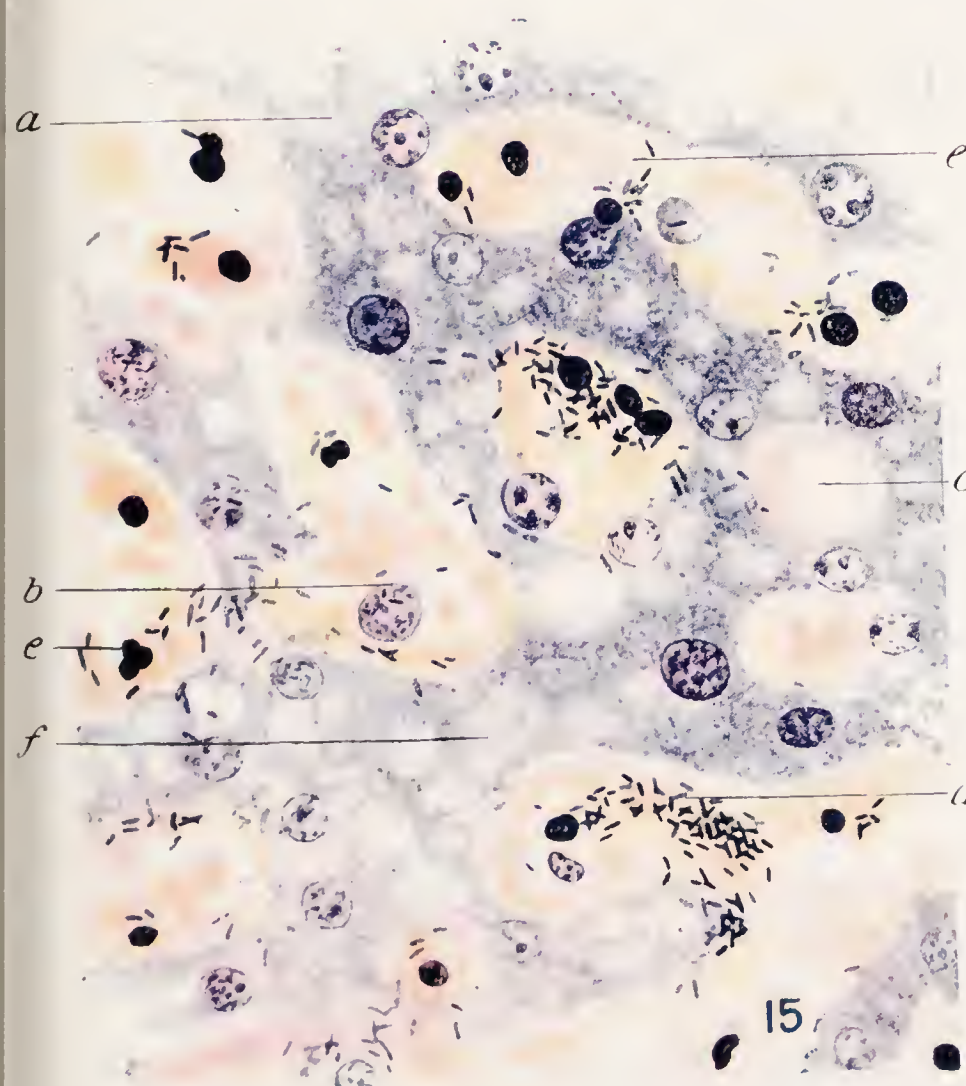
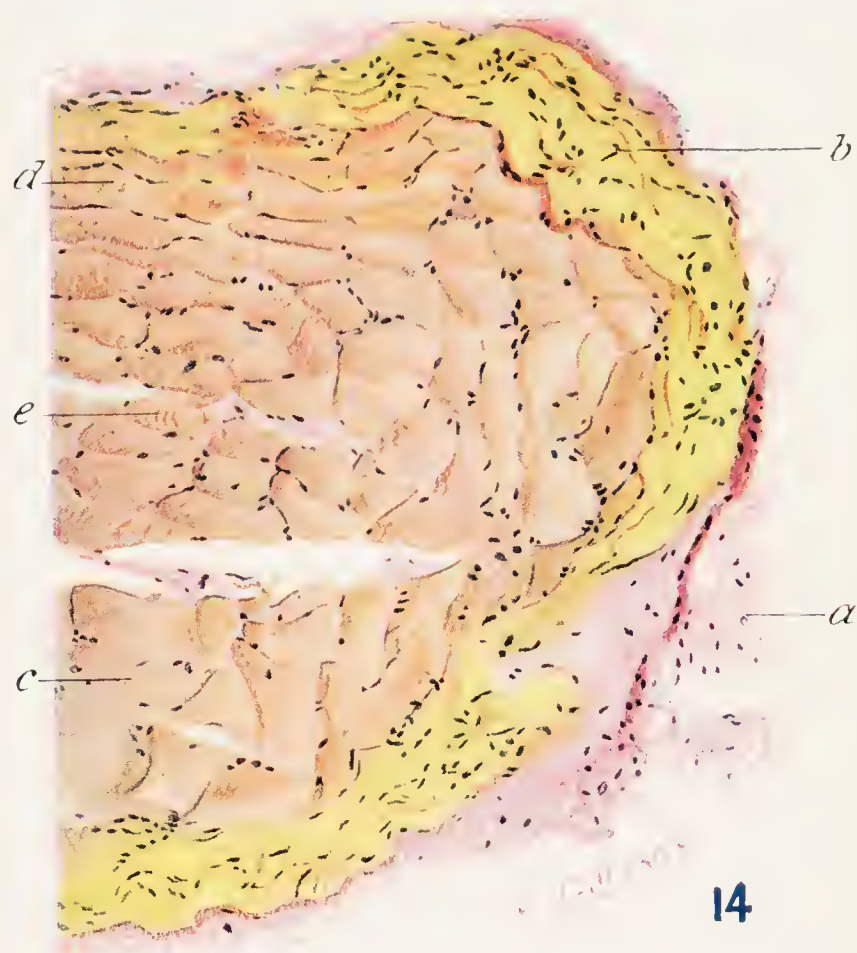






Fig. 13. Same section from near the periphery of the lobule. ( $\times 1000$ .)

- a.* Swollen, granular and vacuolated liver cells.
- b, b.* Swollen membranes of capillary walls.
- c.* Endothelial cells—Kupffer's cells—containing bacilli.
- d.* Similar cell in which nucleus is dividing.
- e.* Polymorphonuclear leucocyte.
- f.* Large vacuole in liver cell—apparently not fat.

Fig. 14. Section of liver from near centre of lobule. ( $\times 1000$ .)

- a.* Swollen wall of portal capillary.
- b.* Granular and vacuolated liver cells.
- c, g.* Masses of plague bacilli in portal capillary.
- d, d.* Cells in earlier stage of cloudy swelling.
- e.* Polymorphonuclear leucocyte.
- f.* Large space from which granular liver tissue has fallen away.
- h.* Group of polymorphonuclear cells.
- i.* Red blood corpuscles.

PLATE XV.

Fig. 15. Section of kidney. These sections are stained with Giemsa's stain. ( $\times 250$ .)

- a.* Point of entrance of afferent arteriole to glomerulus. Note accumulation of leucocytes.
- b.* Plague bacilli lying in capillary vessels.
- c.* Loop of congested capillary tuft. Note swelling and thickening of basement membrane of wall.
- d.* Swollen endothelial cells lining the capillary.
- e.* Swollen cells lining Bowman's capsule.
- f.* Swollen basement membrane of Bowman's capsule.
- g, i.* Granular remains of cloudy and vacuolated columnar epithelial cells lining a convoluted tubule.
- h.* Granular *débris* and red blood corpuscles in convoluted tubule.

Fig. 16. Section from boundary zone of kidney. ( $\times 250$ .)

- a, a'.* Congested vessels in one of which plague bacilli are very numerous, in others they are situated specially on the endothelial cells lining the vessel.
- b.* Disintegrating epithelium similar to that seen in the convoluted tubules nearer the surface of the cortex.
- c.* Bacilli referred to under *a'*.
- d, d.* Swollen basement membranes of tubules and capillaries.



## V. SOME OBSERVATIONS ON RELAPSING FEVER AT TONGSHAN.

(With Plate XVI.)

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### I. *Introduction.*

On March 20th, 1913, I received instructions to inquire into an epidemic of Relapsing Fever in Tongshan. Tongshan is the centre of a coal-mining district in the province of Chihli, and lies about 80 miles by rail North-east of Tientsin. Here are also situated the engineering works of the North China Railways, the Chee Hsin Cement Works, and the coal mines of the Kailan Mining Administration. In the autumn of 1908 a severe outbreak of bubonic plague occurred at Tongshan, killing about 1000 persons. The population of the town is about 30,000: nearly 5000 of them are Cantonese. The mining population numbers about 6000.

I arrived there on March 25th and stayed until April 11th. After arriving at Tongshan I learned that since the beginning of 1912 there had been peculiar cases of fever occurring among the miners working in the Kaiping coal mines. The fever was irregular in type and the cases were confined to a small area in the neighbourhood of Tongshan.

Dr C. F. Andrew was appointed as Acting Medical Officer before my arrival at Tongshan, and it was only after his going there that the true

nature of the fever was diagnosed. From the signs and symptoms of the disease Dr Andrew suspected the cases to be those of relapsing fever and his suspicions were confirmed by finding *Spirochaeta recurrentis* in the blood of some of the patients.

The extent of the epidemic among the miners may be judged from the fact that out of 168 cases admitted into hospital during the months of January—March 1912, 158 (95 %) were miners from the Tongshan district. Having made the diagnosis Dr Andrew commenced intravenous injections of neo-salvarsan, using a tube of Dosage No. 5, *i.e.* 0.75 grammes, for 2 patients. He noticed a marked improvement within 12 hours of injection. Patients shewing jaundice quickly revived under treatment, and only one death was recorded out of over 70 patients treated.

With a view to determining the cause and mode of spread of the epidemic, I carefully investigated the conditions under which the miners lived and the parasites infesting them. I also took the opportunity of studying the clinical features of the epidemic, and treated the patients admitted to hospital during my visit to observe for myself the effects of neo-salvarsan in relapsing fever.

My findings are recorded in this Report.

## II. *Conditions of life among the miners.*

For the most part the miners live in "inns." In many cases an "inn" is merely the inner room of a small retail shop. The rooms have paper windows, and the walls are black with coal dust. They are dark, dirty, and greatly overcrowded. One I visited measured 15 ft.  $\times$  9 ft.  $\times$  20 ft., and contained 12 men: another measured 50 ft.  $\times$  15 ft.  $\times$  12 ft., and in this over 30 men slept at a time. When one shift goes into the mines, the men of the returning shift occupy the beds vacated by their comrades.

The miners seldom wash after they have emerged from the pits. There is rarely any second suit of clothes for sleeping in, and the bedding is filthy. I was told by the contractors that the average earnings of an experienced miner were 25 cents per shift of 8 hours; the charge for board and lodging, amounting to at least 15 cents a day, has to be deducted from this, thus leaving a maximum of 10 cents per day for other necessities. There are 3 regular shifts in the 24 hours, *viz.* 6 a.m. to 2 p.m., 2 p.m. to 10 p.m., and 10 p.m. to 6 a.m., but in order to increase his earnings the miner often attempts a second shift



at an irregular hour in the course of the day. It is seldom possible, however, for him to do more than 4 to 5 shifts in 3 consecutive days, owing to the arduous nature of the work. The food supplied consists of thin cabbage soup and brown millet: they get meat not oftener than once a month. In spite of the unhealthy conditions and poor food the majority of the men appear healthy.

### III. *Chief clinical features observed in the epidemic.*

A large number of the patients were able to walk to the hospital although ill. The symptoms usually complained of by the patients were malaise followed by headache, aching in the bones of the back and limbs, and shortness of breath. The pulse was quick, varying from 90 to 130, regular and easily compressible, and was more significant than the fever: the temperature charts shewed the usual variations observed in relapsing fever. The spleen was often enlarged; albuminuria was present in a large percentage of the cases; jaundice was found to be not necessarily a fatal sign. I observed 3 cases in which jaundice was present: none of these died, while one patient developed it when convalescent. In a few cases pleuritis was a marked feature. The spirochaetes were usually detected in the blood at the height of the fever, though not rarely they were present when the temperature was normal.

### IV. *The discovery of the carrier of the spirochaetes in the epidemic investigated.*

Of 32 patients examined, all had lice but only 2 had bed-bugs. A large number of lice taken from patients whose blood contained *Spirochaeta recurrentis* were dissected and their bodies examined for the spirochaete. In 5 out of 10 cases the *Spirochaeta recurrentis* was found in the stomach contents of the lice—often in very great numbers. Romanowsky's stain was used and found to be quick and good for demonstrating the micro-organism. The bed-bugs were dissected and examined: the blood contained in their alimentary canal was disintegrated and no spirochaetes were found. With lice a series of biting experiments were begun, but there was not time to complete these.

V. *The effects of neo-salvarsan in the treatment of relapsing fever.*

During my stay in Tongshan I made a careful record of 22 cases, especially in regard to the examination of the blood and urine, and to the effects seen after the injection of the drug. None of these 22 cases were fatal, but prior to my visit some fatal cases had been recorded, including two which had also received neo-salvarsan injections.

I propose to indicate in a general way the effects observed after the injection of neo-salvarsan, and to illustrate the findings by giving in greater detail my notes in a few typical cases. In a majority of the cases, for each patient I used a tube of Dosage No. 5, *i.e.* 0·75 grammes. No effect was observable until 6 hours after the injection. The temperature then began to fall quickly, and 12 hours after the injection had reached normal: the pulse decreased in rate, the headache, pains and dyspnoea were greatly relieved, though in some of the cases these symptoms persisted for 24 hours longer. The albumen had disappeared from the urine by the next day, and the urine itself, from being concentrated and dark in colour, became quite clear.

Examination of the blood shewed an increase in the total leucocyte count varying from 9000 to 40,000 (in a case where jaundice was present). Leucocytosis persisted for some days after the injection of the drug, and as the patients left the hospital soon after the symptoms were relieved it was not possible to follow this point further.

After injection films were made from the blood every hour up to the sixth hour, and thereafter every 4 hours. In the majority of cases, about 6 hours after the injection, the spirochaetes were observed to be more elongated in appearance and more concentrated at certain places in the film. Usually the spirochaetes disappeared from the peripheral circulation when the temperature reached normal: but, as previously noted (see Chart III.), this was not constant; in some cases the spirochaetes being found even as long as 24 hours afterwards. They were never encountered later than this.

*Illustrative cases.*

1. Case 169. L. C. Y. Aet. 36. Miner. Admitted 26. III. 13. Complained of fever, dyspnoea, and pain in limbs and back. Pulse 128, resp. 28, temp. 102°. Profuse perspiration, tongue furred. Spleen slightly enlarged. Slight dulness over base of right lung, with diminished air entry: no crepitations (? early stage of pneumonic



consolidation). Urine dark-coloured and contained albumen. Blood shewed presence of spirochaetes. At 5.30 p.m. patient appeared worse. 0.4 grammes of neo-salvarsan injected intravenously. Four hours after injection spirochaetes were still numerous in the blood but were con-

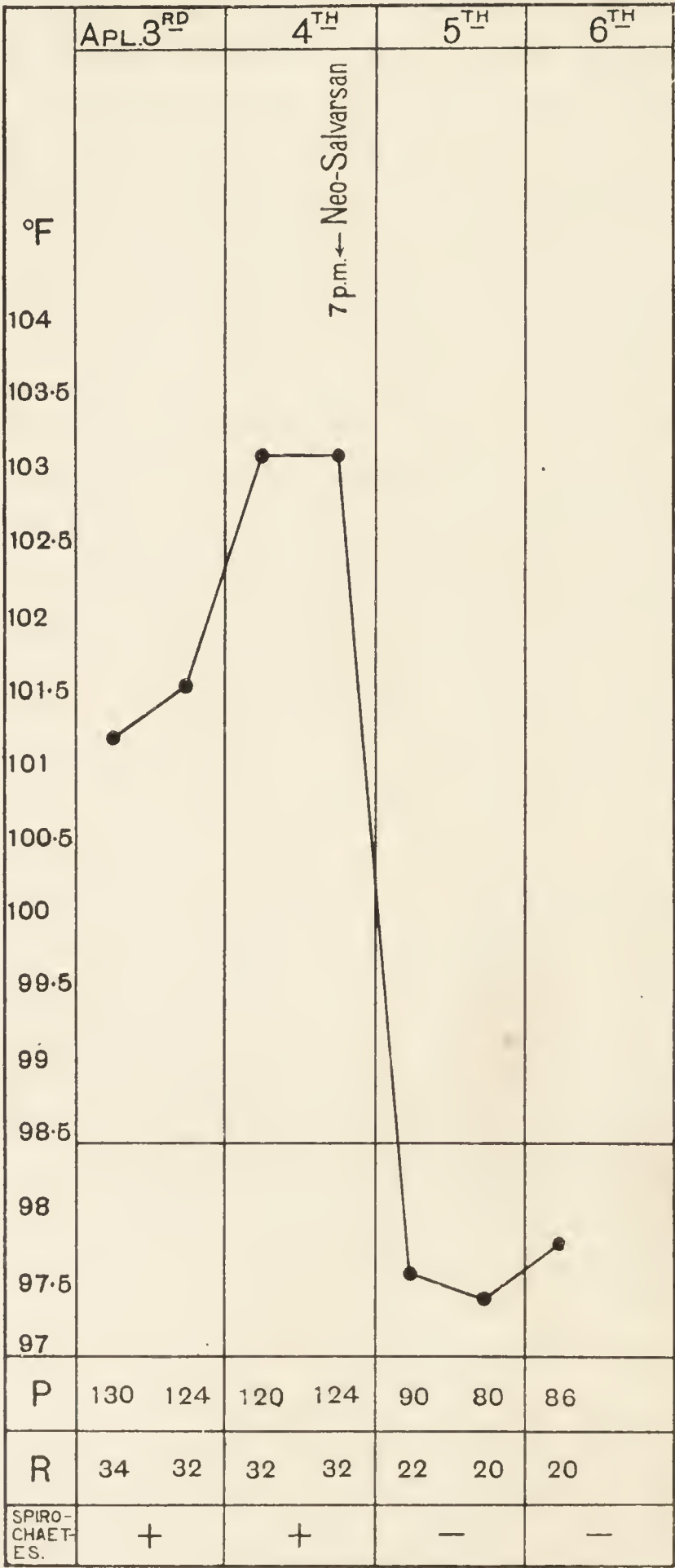


Chart I.

centrated. Six hours after injection spirochaetes were much diminished in number.

27. III. 13. 9 a.m. Patient was jaundiced. Urine yellowish but clear, with trace of albumen. Pain and tenderness over liver. Pulse 108, resp. 40. No spirochaetes to be found in the blood.

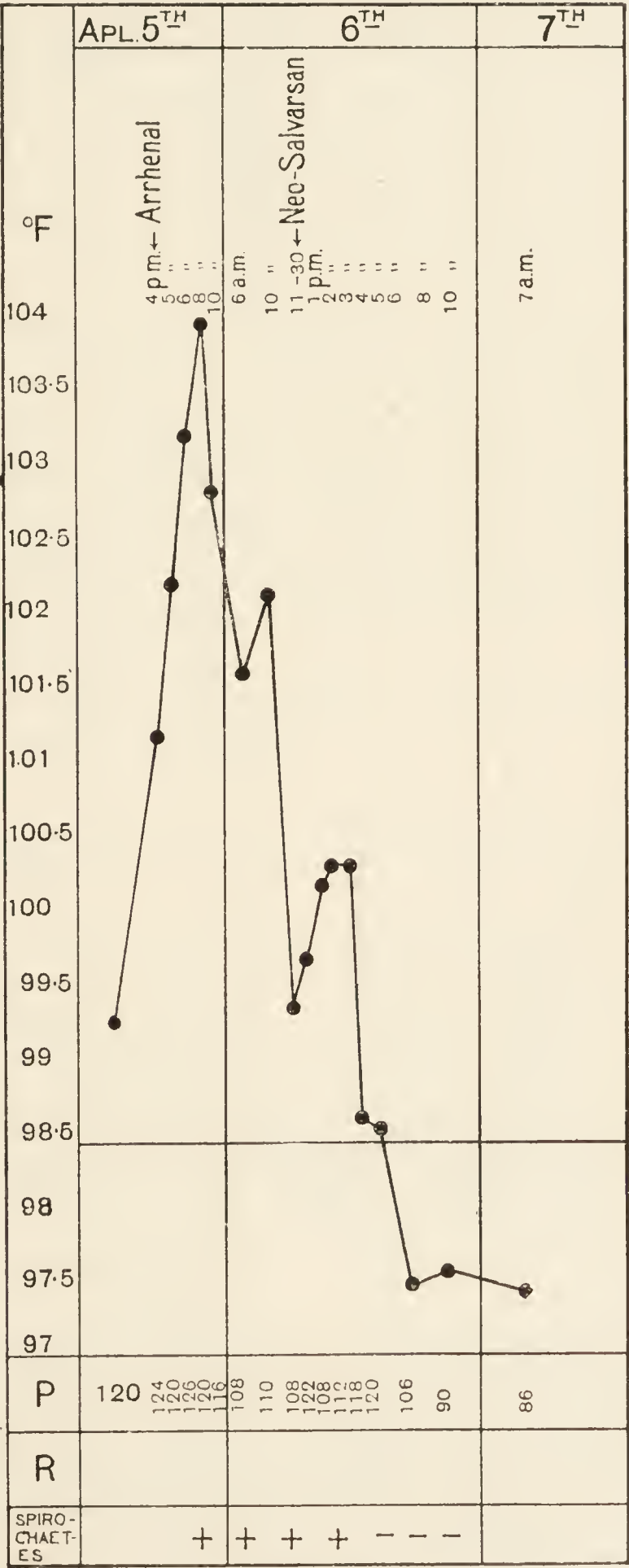


Chart II.



28. III. 13. Condition improved. Pulse 80, resp. 20, temp. 97·5°. Marked jaundice: base of right lung not yet clear: trace of albumen: no spirochaetes in blood.

1. IV. 13. Jaundice still present, lung signs cleared up, but patient was discharged.

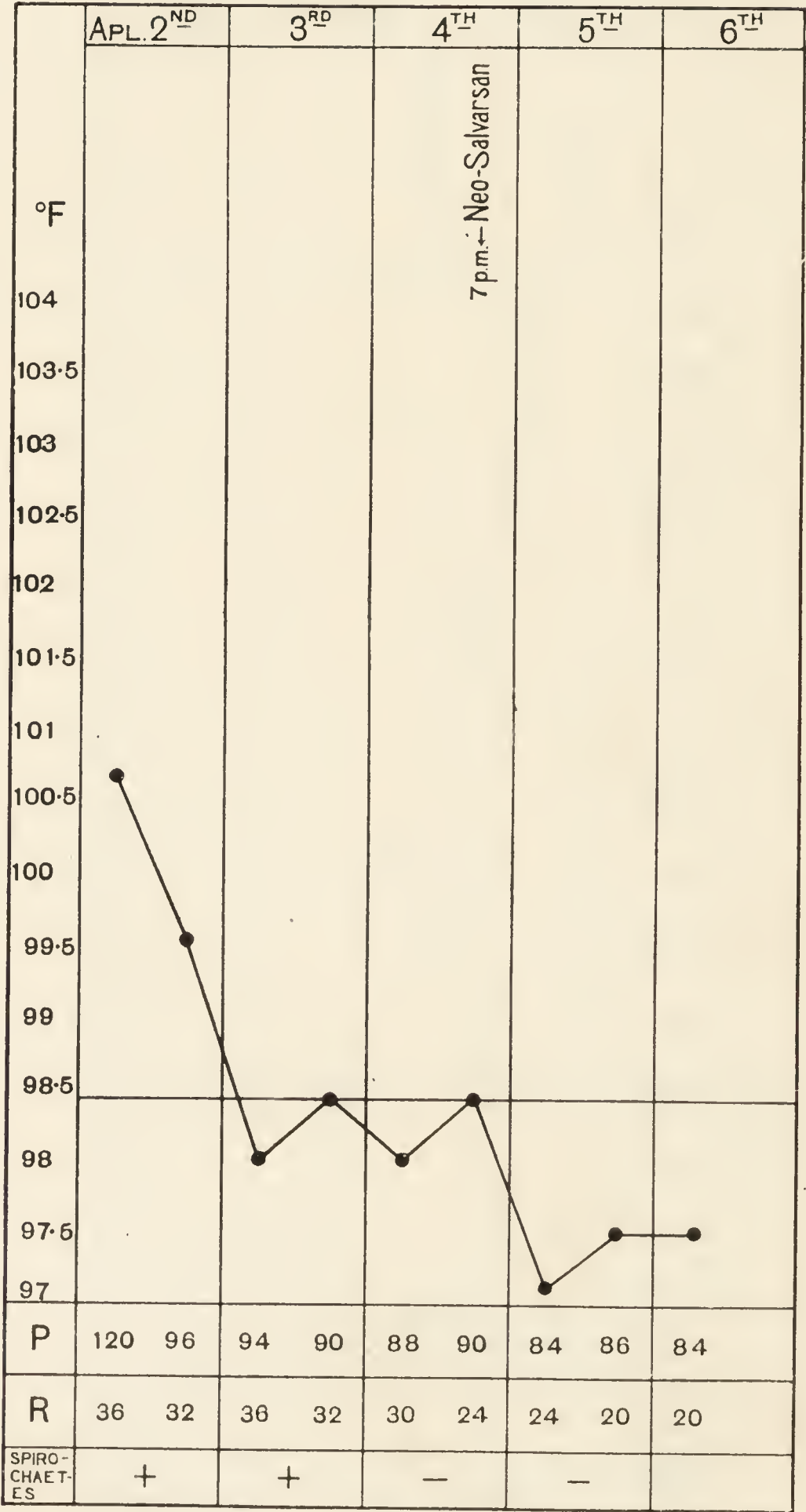


Chart III.

• 2. Case 171. C. L. Y. Miner, aet. 25. Admitted 26. III. 13. Complained of fever, faintness, pains in limbs and back. Pulse 120, resp. 24, temp. 100·5°. General appearance fair. Tongue slightly furred: no jaundice. Abdomen full. Spleen much enlarged. Examination of lungs negative. Urine deep-coloured, with large deposit and containing albumen. Total leucocyte count 9400. Blood shewed many *Spirochaetae recurrentis*.

26. III. 13. 5 p.m. 0·4 gramme of neo-salvarsan injected intravenously. Four hours after injection spirochaetes still present in blood.

27. III. 13. 9 a.m. Temp. 99°, pulse 80. Most of the pain has disappeared. Urine clear, no albumen. Spirochaetes still present in blood.

28. III. 13. Improvement continued. Spirochaetes in blood—nil.

3. Case 180. L. M. S. Miner, aet. 22. Admitted 2. IV. 13. Complained of similar symptoms to the above. Pulse 120, resp. 32, temp. 101·5°. Spleen slightly enlarged. Urine normal. Total leucocyte count 8500. Spirochaetes present in blood. 0·75 grammes neo-salvarsan injected intravenously. Three hours after injection only a few spirochaetes were found in the blood: 6 hours after injection the blood shewed no spirochaetes.

3. IV. 13. (24 hours after injection.) Total leucocytes 11,400: no spirochaetes. Temp. n., pulse 80.

## VI. *The effects of arrhenal in the treatment of relapsing fever.*

It should be noted here that a French arsenical preparation—arrhenal—was also tried by me on patients suffering from relapsing fever. Doses of ·016 gramme were given intravenously. In some cases there was a tendency for the temperature to fall, but the effects were not marked, and micro-organisms were still found in the blood 48 hours after injection. In one case neo-salvarsan was resorted to after failure with arrhenal, and the patient promptly recovered. See Chart II.

## VII. *Measures recommended for stamping out the disease.*

The following are the recommendations I presented to the authorities immediately after my investigations:

1. I consider that relapsing fever is an easily preventible disease if proper measures are adopted, but that, if allowed to continue its



course unchecked, may increase in virulence and extent, thus entailing much loss of life and also of money to the authorities concerned.

2. As I have said above, relapsing fever is at present confined principally to the miners whose unhealthy surroundings and mode of living are important predisposing causes.

3. I recommend that the following measures be adopted, wherever possible, to stamp out the disease:

(a) A systematic cleaning of dirty streets and alleys in the crowded quarters.

(b) A rigid examination of the dwellings occupied by the miners. The contractors who employ the miners, and often rent out houses to them, should be called upon to see that these dwellings are properly ventilated and swept every day, and that plenty of sunlight be admitted into the rooms, and the walls be whitewashed every six months.

(c) Large free baths, which several men could use at the same time, might with advantage be supplied to the miners as soon as they emerge from the pits. At present the cheapest bath obtainable by the miner costs 3 cents, and the tendency thus is to wash as little as possible.

(d) A large steam-pressure steriliser (*e.g.* Washington Lyons' pattern) should be installed in a convenient position, where the clothes of the coolies could be sterilised once a week free of charge. This method will not spoil the clothes, but will kill all the vermin and their eggs hidden inside, thus removing the principal cause of the disease attacking the miners.

(e) Coolies should be provided with an extra suit of clothes and should be given during their spare hours simple lessons in Hygiene, *e.g.* the dangers arising from continually wearing the same clothes.

In conclusion, I wish to express my indebtedness to the Kailan Mining Administration and the medical staff of their hospital for their courtesy in having given me the necessary facilities for carrying out my investigations.





Tongshan. Type of "Inn" where the miners live.



Tongshan. A Relapsing Fever Patient being carried to Hospital by a friend.



Tongshan. Three Relapsing Fever Patients. The middle one had marked Jaundice.





## VI. REPORT ON INVESTIGATIONS AT HAILAR, MANCHOULIE, AND MUKDEN.

(JULY 20TH TO AUG. 7TH.)

BY F. E. REYNOLDS, M.B., CH.B. (EDIN.).

In July—September 1911, Drs Wu and Ch'en, by their work in Eastern Siberia (in conjunction with Professor Zabolotny) and in Mongolia, shewed that the Tarbagan (*Arctomys bobac*, Schreb.) played no direct part in the spread of plague to man<sup>1</sup>, yet we decided, in view of analogous experimental work, to try and determine if the Tarbagan flea (*Ceratophyllus silantievi*, Wagner) could carry plague from an infected to a healthy Tarbagan. For the purposes of such experiments a large number of fleas would be required, and the first thing to be done would be to collect fleas from the Tarbagan and breed them. Owing to the absence of Drs Wu and Ch'en from Harbin I was unable to leave for the Tarbagan regions until July 20th. On that date I left for Hailar, arriving there on the following day. I stayed at Hailar from July 21st to 26th, and then went to Manchoulie, where I stayed from July 26th to August 7th, leaving for Harbin on the latter date. For reasons which will appear later, we decided that I should also visit Mukden to study the fleas of *Spermophilus citellus*, Linn., a small species of marmot (gopher) which is found in that region. The findings in Manchuria and in Mukden are recorded in this Preliminary Report.

Both at Hailar and Manchoulie Tarbagan hunters were engaged to catch the animals at the rate of Roubles 2 per live animal brought in.

### *Hailar.*

On the three days after my arrival (July 22nd, 23rd, and 24th), I rode into the country around to try and find the haunts of the animals, no Tarbagan burrows having been visible in the immediate vicinity of the town. In this way the country within a radius of about 10 miles was examined but no trace of Tarbagans was found.

<sup>1</sup> *Journal of Hygiene*, October 1913.



On the evening of July 24th one of the hunters brought in two ♂ Tarbagans. These had been caught early in the morning and it had taken the man all day to reach Hailar. As far as I could understand, the animals had been captured among the hills lying south of the town. One of the animals was a large specimen, and was carried in a basket: the other one was smaller and was brought in in an old kerosene tin. The latter Tarbagan was very wet and dirty. Both animals were immediately chloroformed and examined for parasites, with the following results:

*July 24th, 1913.*

Large Tarbagan (♂):—1. No fleas.

2. 22 ticks taken mostly from the ventral surface (Species *Rhipicephalus*).

Small Tarbagan (♂):—1. 2 fleas taken from the back of the animal; both were *Ceratophyllus silantievi*,—1 ♂, 1 ♀. The body of the ♀ flea apparently contained eggs.

2. 2 ticks taken from the breast.

Both the Tarbagans were killed, but no more parasites were seen to leave the bodies during and after cooling.

On the following day the ♀ flea was active, but the ♂ was motionless. On examining the latter under the microscope, the intestines were seen to contain blood and were in active peristaltic movement. After a few moments the flea raised itself on its side.

On the next day (July 26th) the ♂ flea was dead: the ♀ flea was active but refused to feed on a human being. Up to July 28th repeated attempts to induce the ♀ flea to feed on the human arm had been unsuccessful, and on the evening of that day,—4 days after capture,—it died.

There being no likelihood of obtaining more Tarbagans at Hailar I left for Manchoulie and arrived there on the evening of July 26th.

*Manchoulie.*

About 1½ miles north of Manchoulie, among the hills, many Tarbagan burrows were found, and in this neighbourhood many of the animals were to be seen.

*July 31st, 1913.*

In the evening 2 ♂ Tarbagans were brought in, and the result of examination was as follows:

T. 1:—♂, 4 fleas, 3 ticks.

T. 2:—♂, 0   ,,   3   ,,

The 4 fleas were *Ceratophyllus silantievi*, and of them 3 were ♂, and 1 ♀. They refused to feed either on the shaven or unshaven abdomen of a Tarbagan or on the human arm, and died two days after capture.

August 2nd, 1913.

In the evening 3 ♂ Tarbagans were brought in, all in the same box. One of the animals had died on the way, but when examined was not quite cold. Post-mortem examination of this animal shewed its organs to be perfectly healthy. (It is no uncommon thing for Tarbagans to develop a high temperature after capture and to die with no post-mortem signs of disease<sup>1</sup>.)

Examination of the 3 animals for parasites shewed:

T. 1:—dead (♂), 2 fleas, 0 ticks.

T. 2:— (♂), 19 ,, 0 ,,

T. 3:— (♂), 0 ,, 2 ,,

Of these 21 fleas, 6 were ♂, and 15 were ♀.

On the following day the 21 fleas were given facilities for feeding on the shaven or unshaven abdomen of a Tarbagan: a few were noticed to feed but the majority refused. Two days after capture only 13 were alive, and of these only 2 could be induced to feed on the Tarbagan. Three days after capture all the fleas were dead.

August 4th, 1913.

In the morning 1 ♂ Tarbagan was brought in. No fleas and no ticks were found upon it.

August 6th, 1913.

Late in the evening of the 5th, 4 Tarbagans were brought in. They were examined for fleas early on the 6th.

T. 1:—♀, 0 fleas, 11 lice.

T. 2:—♂, 1 flea.

T. 3:—♂, 3 fleas.

T. 4:—♂, 4 ,,

Of these 8 fleas, 3 were ♂, and 5 ♀.

In all then, 12 Tarbagans were examined: these had a flea count of: 0, 2, 4, 0, 2 (dead Tarbagan), 19, 0, 0, 0, 1, 3, 4, thus giving a total of 35, and an average count of  $2\frac{1}{2}$  fleas per animal. All the fleas obtained were *Ceratophyllus silantievi*.

<sup>1</sup> See Report on investigations carried out in Mongolia and Siberia in 1911.



A few of the fleas were found on the back of the animals, but the great majority were about the hind quarters.

Owing to the impossibility of keeping the fleas alive, it was useless to stay longer collecting them. I therefore returned to Harbin, arriving there on August 8th. After reporting the result of these investigations to Dr Ch'en, we both agreed that the next step to be taken to try and overcome the difficulty of not being able to keep the fleas alive was to place the fleas as soon as captured on a host in a flea-proof cage so that the fleas might be in surroundings as natural as possible. For such a purpose the Tarbagan is too big an animal to be convenient, and owing to its large excreta the cage would soon become too dirty and wet. We therefore agreed that it would be best to investigate the small species of marmot (*Spermophilus citellus*, Linn.) found in the neighbourhood of Mukden in regard to the species of flea living upon it, and the part of the animal infested.

Owing to the opening of the Hospital at Harbin (August 27th) my departure for Mukden was delayed until September 2nd.

*Table shewing flea-counts of captured Tarbagans.*

Date	Sex of Tarbagan	Total No. of fleas	No. of ♂ fleas	No. of ♀ fleas
July 24	♂	0	—	—
„	♂	2	1	1
July 31	♂	4	3	1
„	♂	0	—	—
Aug. 2	♂ dead	2	6	15
„	♂	19		
„	♂	0	—	—
Aug. 4	♂	0	—	—
Aug. 6	♀	0	—	—
„	♂	1	3	5
„	♂	3		
„	♂	4		
Total	12	35	13	22

*Addendum.*

The Tarbagan flea appears particularly susceptible to the effects of chloroform and it seems very probable that the early deaths of the fleas were due to the chloroforming necessary in their handling. Drs Wu and Ch'en kept fleas alive for as long as 7 days without feeding them.

INVESTIGATIONS AT MUKDEN. (SEPT. 4TH TO 16TH.)

Arriving in Mukden on September 4th, I was told that the small marmots (gophers) lived in large numbers among the graves between the town and the Eastern Tombs. About a month before they were to be seen in great numbers but lately very few had been observed, they having for the most part gone underground preparatory to hibernating. On visiting the neighbourhood several times during my two weeks' stay in Mukden, I did not see a single animal although very many burrows were found. Most of the burrows went into a grave, so digging operations could not be carried out.

In the afternoon of Sept. 8th 1 ♂ *Spermophilus citellus* was brought in. The animal was chloroformed immediately and examined for fleas. Six fleas were found; these fell off during the chloroforming into the jar containing the marmot, and so it could not be ascertained on what part of the body they lived. The fleas quickly recovered from the chloroforming, being quite active 5 to 10 minutes after. Twenty-four large ticks were counted: these were macroscopically similar to those found on the Tarbagan. Half of these ticks were grouped in two bunches of 7 and 5 respectively, and their heads were buried in the skin of the host. The ticks were on the underneath part and at the side of the neck, in the axillae, and on the upper parts of the forelimbs.

On the following morning the marmot died. Since chloroforming (the animal was not deeply under) it had been sluggish, but shewed no signs of any particular affection, while post-mortem examination failed to reveal any evidence of disease in the organs<sup>1</sup>. Soon after its death, ticks began to leave the body in large numbers, the large ones coming mostly from the head end, but some were seen leaving other parts of the body. Small ticks were seen leaving all parts of the body. In all 121 ticks were collected.

Late in the evening of Sept. 10th 2 ♂ marmots were brought in in an old kerosene tin: they were examined early next morning for fleas. From the body of one of the animals 4 fleas were taken, and from the other 15. Of the latter 13 fell off into the jar during chloroforming; 1 was taken from the neck, and 1 from the body. All the 6 fleas taken from the animals were found on the dorsum or sides, but the ventral surfaces of both animals were wet. About 10 minutes after removal into tubes the fleas began to recover from the effects of the chloroform

<sup>1</sup> See Report on investigations carried out in Mongolia and Siberia in 1911.



and to move about actively. Both these marmots had large numbers of ticks, many of them being in bunches, especially on the under side of the neck.

On the morning of Sept. 12th 5 marmots were brought in in the same tin. They were chloroformed and the result of the examination was as follows :

Marmot 1.	♂.	4 fleas,—2 fell off during chloroforming, 1 found on hind quarters, 1 on the body.
„ 2.	♂.	2 fleas,—both on hind quarters.
„ 3.	♂.	1 flea,—fell off during chloroforming.
„ 4.	♂.	2 fleas,— „ „ „
„ 5.	♂.	2 fleas,— „ „ „

The first four of the above animals had large numbers of big ticks, many of them in bunches on the underneath part of the neck and in the axillae.

The fifth animal had only a few ticks.

All the fleas obtained belong to the genus *Ceratophyllus*, but the species has not yet been identified.

To summarise :—8 ♂ *Spermophilus citellus* were examined. The flea count was 6, 4, 15, 4, 2, 1, 2, 2—thus giving a total of 36 fleas and an average of  $4\frac{1}{2}$  fleas per animal.

The following table shews the number of ♂ and ♀ fleas obtained :

Date	<i>Spermophilus citellus</i>	No. of fleas found	No. of fleas examined	♂ fleas	♀ fleas
Sept. 8	♂	6	4*	2	2
Sept. 11	♂	4	3*	0	3
„	♂	15	11*	6	5
Sept. 12	♂	4	4	1	3
„	♂	2	2	1	1
„	♂	1	1	0	1
„	♂	2	2	0	2
„	♂	2	2	1	1
Total	8	36	29*	11	18

\* Seven fleas were lost owing to an accident in mounting.

As a result of these findings at Mukden,—viz. that the flea of *Spermophilus citellus* is of the genus *Ceratophyllus*, and lives about the hind quarters of the animal,—we propose next year, when the Tarbagans have come out from their winter hibernation, to proceed to Manchoulie and there collect fleas. The fleas obtained will be immediately put into a flea-proof cage containing a *Spermophilus citellus* with a view to keeping them alive for further investigations.

## VII. THE ISOLATION CAMPS OF THE NORTH CHINA RAILWAYS.

(With Plates XVII, XVIII.)

Owing to the sudden and rapid spread of the Pneumonic plague epidemic in the winter of 1910-11, the Railway and Provincial authorities, acting upon expert advice, erected a series of Isolation camps and detention sheds at the principal railway stations in Manchuria and North China. This plan was decided upon because the epidemic had spread from the North principally by the railway. It was found that many passengers, especially in the 2nd and 3rd classes, had already been infected when they boarded the trains and thus carried the disease to their fellow-passengers. The object of these Isolation camps was to isolate the sick when necessary, to detain the passengers until the quarantine period was over and to enable the medical officers to carry out their work with greater care and safety to themselves. The plans and work of construction were left in the hands of the district engineer. As winter had not yet passed, and the ground was still frozen to a depth of 3 feet at many places, it was decided to build only temporary wooden supports and to use corrugated iron roofing, wherever possible, in the case of the quarantine wards. The actual plague and suspect wards were principally built of wood.

The following are the cities where detention camps were constructed at the beginning of 1911:

### A. *Mukden*—Capital of Manchuria.

Owing to the distance of the city from the railway station, it was necessary to erect two hospitals, one close to the city walls and the other at the railway station.

(a) *Station Isolation Camp*. The buildings are divided into three classes.

16	1st	class	compartments	each	holding	2	persons	...	32
12	2nd	"	"	"	"	4	"	...	48
36	3rd	"	"	"	"	6	"	...	216
									<u>296</u>



(b) *City Isolation Camp.* Containing 29 blocks divided as follows :

10 large ones each accommodating 30 persons	...	300
15 medium sized ones each	„ 10 „	... 150
4 small ones each	„ 6 „	... 24
		<u>474</u>

There is a hot water plant erected to warm the rooms during the cold weather. The roofs and walls of these buildings were constructed with corrugated iron sheetings, whilst the supports and floor were made of wood.

B. *Koupangtzu*—the railway junction of the Yingkow and Peking-Mukden sections of the North China Railways.

The detention camp here is situated about a hundred yards from the station and consists of 6 large blocks each capable of holding 40 persons, and 3 smaller ones holding 25 persons. There is thus accommodation for at least 315 people.

C. *Yingkow (Newchwang).*

This is an important sea-port for vessels plying between Shanghai, Hongkong and Japan and also a railway centre for the Chinese Government and South Manchurian Railways. It may be remembered that an epidemic of Bubonic plague occurred here and in the neighbouring districts in the winter of 1899 which killed over 2000 people, but it escaped the epidemic of 1910-11.

There are 2 camps at Yingkow.

(a) At the railway station on the North shore of the river. There are 4 blocks of 12 rooms each with accommodation for 240 people. Each block is fitted with wooden kang, separate yards and lavatories, the whole being surrounded by an iron fence.

(b) On the South side of the river, for passengers arriving by steamers. The following is the distribution of the blocks :

1 block containing 20 rooms for 40 1st class passengers	
1 „ „ 10 „ 60 2nd „ „	
14 blocks „ 189 „ 1890 3rd „ „	
4 „ „ 32 „ 192 Contact cases	
2 „ „ 20 „ 20 Suspect „	
2 „ „ 20 „ 20 Plague „	

There is therefore a total accommodation for 2220 persons.

Besides the above there is accommodation for 4 medical officers, sanitary attendants, police, luggage, laundry, kitchens and disinfection apparatus.



Koupangtzu Railway Station. Isolation Hospital on the right.



Yinkow (Newchwang) Isolation Camp.







Separate Plague Wards at Shanhaikwan (at the end of the Great Wall).





(For the above information I am indebted to Dr W. Phillips, Customs Surgeon of the port.)

D. *Shanhaikuan*, which is the terminus at the sea of the Great Wall, lies mid-way between Peking and Mukden on the railway. The Isolation camp is situated a mile outside the city and also some distance outside the Great Wall. It consists of 2 parts separated by the railway track.

(a) On the North side are :

- (i) A brick building for the medical officer.
  - (ii) Eight iron sheds for the staff and administration.
  - (iii) Four rows of wooden blocks capable of holding 350 people.
- All these buildings are surrounded by a wooden enclosure.

(b) On the South side of the track are 12 separate wooden blocks for plague and suspect patients. Each of these has accommodation for 4 persons. Water is supplied by a special tower and the buildings are fitted with steam pipes.

Owing to hasty construction and the frozen state of the ground at the time, some of the supports of these detention camps have already given way, and it will be advisable to make the necessary repairs as soon as possible.



## NORTH MANCHURIAN PLAGUE PREVENTION SERVICE.

(With Plate XIX.)

### VIII. FIRST DECEMBER QUARTERLY REPORT, 1912.

HARBIN, 25th January.

SIR,

I have the honour to submit the first Quarterly Report of the North Manchurian Plague Prevention Service.

2. I left Peking on October 1st and called upon the Tutuh of Fengtien (Mr Chao Erh Sen) at Moukden on my way up here and received from him two despatches, for the Tutuhs of Kirin and Heilungkiang respectively.

3. I arrived at Harbin on October 12th and at once set to work to organise the Service. The Commissioner of Customs placed at my disposal a room in the Customs Buildings for the purpose of the Central Office, where the Director, Accountant, and Secretaries may perform their tasks. In this undertaking, I am glad to acknowledge the valuable assistance rendered by the Commissioner of Customs.

4. On October 14th I proceeded by steamer on a visit of inspection to the Lahasusu Hospital, but the cold weather set in unexpectedly three weeks before its proper time, and I reached my destination with difficulty on October 22nd. The river being frozen, it was impossible to return by steamer and so I waited until the Amur was frozen hard enough for a sledge to cross over. This was accomplished on November 13th, and after a journey of three days and nights along the northern bank of the Amur, the city of Habarovsk was reached on November 16th. Whilst in that city, I called on His Excellency Gondatti, the Governor-General of the Amur Provinces, whom I had known in Harbin during plague times. From there I returned by railway to Harbin, which I reached on November 19th.

5. I travelled to Pukwei on December 2nd to pay my respects to the Tutuh of Heilungkiang (Mr Sung Hsiao Lien), and after consultation with Mr Chang Shou Tseng, Director of the Foreign Bureau (formerly Prefect of Lupinfu) suggested that the balance of the funds which had been appropriated for the building of the Manchouli Hospital be passed over to the Service for the construction of the Taheiho Hospital next spring.

6. Since my return here I have been mainly occupied with the work of general administration, of sending orders to Europe, Japan and America, for drugs and hospital equipments, and of superintending the preparation for the opening of the Harbin Hospital.

7. On December 9th the Russian papers here published reports of alleged cases of pneumonic plague having broken out both in the Transbaikal Provinces and also at a Chinese village near Changchunling in Kirin, which is situated about 180 li north-west of Taolaichiao station (Chinese Eastern Railway). The cases in the Transbaikal Provinces were confirmed by the Russian doctor Haffkine to be true plague. In regard to the second, I despatched Dr S. P. Chen with two assistants on December 15th to investigate the matter. I am happy to state that the report presented by Dr Chen on his return was to the effect that no plague in any form whatever had occurred as alleged by the Russians. This report was later on confirmed by the two Japanese physicians sent there by the Kuantung Government and the South Manchuria Railway.

8. I venture to submit further items in this report under their separate headings.

### *I. Hospitals.*

It may be remembered that after representations from the Waiwupu regarding the steps necessary to prevent recurrence of the serious epidemic of plague (1910-1911), the Viceroy of Moukden (Mr Chao Erh Sen) sanctioned in July 1911 the following appropriations for the construction and equipment of certain hospitals in Manchuria:

(a) Harbin Hospital:—Tls. 50,000.00 equal to Roubles 65,000.00 to be drawn from the Customs Revenue.

(b) Manchouli Hospital:—Tls. 40,000.00 from the surplus of the Plague Prevention work, Fengtien.

(c) Lahasusu Hospital:—Roubles 20,000.00 to be drawn direct from the Customs Revenue.



## A. HARBIN HOSPITAL.

The preliminary arrangements regarding the funds having been made, the Taotai of Harbin (Mr Li Chia Ao) was instructed by the Viceroy to superintend the building of the hospital. Plans were drawn by the Customs clerk of works (Mr Thomas) according to my suggestions, and the contract price accepted for the building of the whole hospital was Roubles 50,000.00. The site chosen was on rather low-lying land midway between the Russian New Town (situated on elevated ground) and Fuchiatien. A higher level would have been more desirable for the purpose, but it was the best we had at our disposal. I was away in Europe and in Peking during the greater part of the time this hospital was being constructed, and so was unable to give any personal attention to it. The work of construction was hurried, no experienced man being employed to supervise the building, and the result is that several parts, such as the damp-proof arrangements, walls, stoves, floors, etc., have not been satisfactorily completed.

Besides the cost of contract, the sum of Roubles 3,098.50 has been paid by the Taotai for additions and alterations, so that a balance of Roubles 11,901.50 is now left with the Treasurer out of the original appropriation of Roubles 65,000.00.

The Harbin Hospital was opened for the treatment of patients on December 16th. It is proposed to use part of the buildings, when no epidemic of plague exists, for the treatment of general hospital cases.

## B. MANCHOULI HOSPITAL.

The sum sanctioned for the building of the above hospital was entrusted to the Heilungkiang Government, whose representative the Prefect of Lupinfu, Mr Chang Shou Tseng, worked in harmony with our Medical Officer, Dr Chu Shen Wei. Plans were drawn by the local Russian Railway engineer for the sum of Roubles 800 and the work of construction began in the autumn of 1911, but, unfortunately, political troubles put a stop to everything. All through, the money was handled by the Heilungkiang Government and I was informed by Mr Chang on my visit to Pukwei (December 2nd—5th) that the following is the complete account up to date.





Medical Officers of the North Manchurian Plague Prevention Service, 1913.





Money sent from Moukden		Tls. 40,000.00
Loss by exchange	... Tls. 1,200.00	
Cost of construction up to date, materials bought etc.	<u>10,712.878</u>	<u>11,912.878</u>
Balance left over		Tls. <u>28,087.122</u>

This sum I have written to the Tutuh of Heilungkiang to hand over to the Service, and I have since received a reply agreeing to my proposal as referred to above (Par. 5).

#### C. LAHASUSU HOSPITAL AND DOCTOR'S QUARTERS.

The sum sanctioned for this hospital was Roubles 20,000.00 and the work of overseeing its construction was undertaken by the Harbin Commissioner of Customs. The tender accepted for construction was Roubles 18,757.00 but the contractor absconded before the buildings were finished. The new Prefect, Mr Lin Chang Chih, undertook to see to its completion, and at the time of my visit (October to November), all the blocks with the exception of the stoves were nearly completed.

Dr Luk Chun Hsuan, the medical officer in charge, has moved into the residence built for the doctor since the beginning of October, and has begun treating patients since October 16th.

The following is a statement of the accounts of this hospital:

Sum sanctioned		Roubles 20,000.00
Money advanced to Contractor	Rbles. 15,650.00	
Money paid Prefect Lin for completion	„ 1,500.00	
Purchase of land etc.	„ <u>682.58</u>	„ <u>17,832.58</u>
Balance left for Equipment, Drugs etc.		Roubles <u>2,167.42</u>

#### D. TAHEIHO HOSPITAL.

The money required for the construction and equipment of this hospital has not been granted, but when I visited the Tutuh of Heilungkiang, I proposed that the balance of the funds left from Manchouli might be utilised for the Taheiho Hospital. The presence of a hospital in this city, situated as it is exactly opposite the Russian town of Blagovestchensk, is of the utmost importance, and the original proposal to station a European qualified doctor there will be carried out. I am glad to state that the Tutuh, in a despatch dated December 23rd, has agreed to utilise the funds according to my suggestion.



## E. SANSING HOSPITAL.

No funds were earmarked for Sansing at the time the Service was started. On January 23rd, 1913, I paid a visit to the Tutuh of Kirin (Mr Chen Chao Chang), and laid before him and the Minchengssu the circumstances of the case. Both the Tutuh and the Minchengssu promised to use their best endeavours to find some suitable existing building, as well as to provide a sum of Taels 10,000.00 for equipment and any alterations that may be necessary.

II. *Medical Officers.*

It may be remembered that at the time of the plague in Harbin, there was considerable fear on the part of the Russian authorities lest the epidemic should spread across the frontier. Hence the Waiwupu and the Inspector-General of Customs instructed myself and the Commissioner of Customs respectively to employ suitable doctors for the purpose. Dr William Kirk was therefore wired for by the Commissioner of Customs, and arrived at Harbin in April 1911. He resigned his post in February 1912.

Dr P. M. Jee and Dr S. P. Chen were appointed upon my recommendation. Dr Jee joined the Service on the 17th day of the 4th moon 1911, and left it in March 1912. Dr Chen joined the Service on June 9th, 1911, and is now Senior Medical Officer in charge of the Harbin Hospital. Another doctor, Luk Chun Hsuan, who had been with me all through the plague, was appointed Medical Officer on the 10th day of the 5th moon 1911, and has been stationed at Lahasusu since June 1911. Dr Tsang Tsung Nien joined the Service from November 16th as Assistant Medical Officer at the Harbin Hospital. It is proposed to appoint new Medical Officers who will be selected from well qualified graduates of European and Chinese universities for the other stations at the earliest opportunity.

III. *Veterinary Surgeon.*

As large numbers of horses and cattle die yearly from obscure infectious diseases which entail huge losses on the agricultural population it seems to me that the employment of a properly qualified veterinary surgeon to inquire into these diseases is necessary, in view of the immense benefit which will undoubtedly accrue to both Government

and people. On my way up to Lahasusu, the local authorities and merchants urged me to devise means for the prevention of further losses to the community. Whilst in Kirin, the Tutuh also expressed to me the need of a veterinary surgeon, as he had frequently been obliged to pay foreign veterinary surgeons for work done in this connection. For this purpose, however, a special appropriation will be required.

I have the honour to be,

Sir,

Your obedient servant,

(Sgd.) WU LIEN TEH.



## IX. FIRST MARCH QUARTERLY REPORT, 1913.

HARBIN, *May 1st.*

SIR,

I have the honour to submit the second Quarterly Report of the North Manchurian Plague Prevention Service for the period ending 31st March, 1913.

2. In order to make a thorough study of the hospitals and stations at the disposal of the Government should another epidemic of Pneumonic Plague occur in Manchuria and North China, I started on a tour commencing from Peking on January 1st, visiting in turn Hankow (by the Peking-Hankow Line); Shanghai (by steamer); Nanking (by the Shanghai-Nanking Railway); Pukow and Tientsin (by the Tientsin-Pukow Railway); Shanhaikuan and Mukden (by the Peking-Mukden Line). A full account of the above hospitals and stations I shall embody in my Annual Report in September of this year. I took the opportunity, when in Shanghai, of visiting the well-equipped institutions and hospitals for dealing with sanitation and infectious diseases under the care of Dr Stanley, whose work there is bearing excellent fruit, especially regarding the prevention of Bubonic Plague. I returned to Harbin on January 26th after having called on Tutuh Ch'en at Kirin on January 23rd.

3. Early in February Dr Tang, Assistant Medical Officer, Harbin, and I carried out some investigations on the variations of temperature inside and outside of Chinese houses during winter, both in Harbin and Changchun. Observations were taken for six weeks in succession, and I communicated the results through the American Consul to Dr Teague, one of America's delegates at the Plague Conference, 1911, who was greatly interested in the question. The results obtained are very instructive and have an important bearing on our knowledge of the spread of plague, and will be published in the proper scientific journals.

4. On March 4th I received a communication from the Wai Chiao Pu regarding an outbreak of Relapsing Fever at Tongshan and the effect of the newly discovered drug—Neosalvarsan—upon it. In order to conduct some researches into this interesting disease I asked for permission to visit Tongshan. Both the Board of Communications and the Kailan Mining Authorities placed at my disposal every facility to conduct these investigations, and I have the pleasure to state that my work has succeeded in establishing the connection between the body-louse—an insect always present on the winter clothes of the miners—and Relapsing Fever. It appears probable that the body-louse, after having bitten a fever patient, conveyed the spirochaetes (germs) to another person, thus giving rise to the disease in man. A summary of my researches and recommendations I sent to the Board on April 30th.

5. In regard to Harbin Hospital, much progress has been made in laying out proper macadamised roads and paths inside and outside the compounds, and also in additions and alterations to the buildings for the proper accommodation of patients. Among other equipments I have ordered a large steam-pressure Disinfector (Thresh's pattern) at a cost of £272, capable of disinfecting complete beds and mattresses. A water-tower fitted with an iron tank and powerful pump is also being erected in the front quadrangle of the Quarantine Block at a cost of Roubles 1400.

6. The health of Fuchiatien has on the whole been good. Much small-pox has lately occurred among Russians in the Railway area, resulting in a few deaths. Vaccination is performed by us, free of charge, twice a week, and pamphlets are being issued to instruct the people regarding sanitation and healthy living. Popular lectures illustrated with pictures and lantern slides are also being given by our medical officers.

7. In a communication dated May 1st I informed the Board that the sum of Taels 28,087.122,—equal to Roubles 36,877.98,—for the construction and equipment of Taheiho Hospital had been received and handed over to the Treasurer for safe keeping.

8. The Rivers Sungari and Amur are now open for navigation and I hope within a fortnight to start for Sansing and Taheiho where the two new hospitals will be established. Regarding the former, Mr Chien Hsi En, manager of the Kirin Government Bank at Sansing, who was instructed by Tutuh Ch'en to find suitable buildings for the purpose, has written to say that there are three sites at present available.



9. I beg to enclose the following:

(a) A description of Harbin Hospital, with reference to its construction and accommodation,—with photographs, and a report on the work done during the first quarter.

(b) A description of Lahasusu and its Hospital,—with photographs.

(c) A description of Fish-skin Tartars,—with photographs.

(d) A description of the expedition to Taichi to investigate the truth of the rumour about plague having occurred there. (In my last Quarterly Report I mentioned that Dr Ch'en, who was sent to the spot at the end of December, was able to contradict the false news.)

(e) A copy in Chinese and English of the Regulations concerning Medical Officers and Hospitals.

(f) A copy of the Memo. on Accounts drawn up by the Lay Director and Treasurer.

I have the honour to be,

Sir,

Your obedient servant,

(Sgd.) WU LIEN TEH.

To The Minister and Vice-Minister  
for Foreign Affairs,  
Wai Chiao Pu,  
PEKING.

## X. DESCRIPTION OF THE HARBIN HOSPITAL.

BY S. P. CH'EN, M.B., B.C. (CANTAB.).

In consequence of the terrible epidemic of Pneumonic plague in Manchuria during the winter of 1910-1911, which was of special severity in Fuchiatien, Harbin, the Government invited the Governments of the various countries having Legations in Peking to send representatives to an International Plague Conference, to discuss and devise plans for combating another such epidemic should it occur again. Twelve nations responded, and the International Plague Conference held its first meeting in Mukden on April 3rd, 1911, with Dr Wu Lien Teh, the Chief Medical Officer of the Chinese Plague Commission, and Senior Chinese Delegate to the Conference, as President. This Conference concluded its sittings at the end of April.

The following were among the resolutions passed:

1. "The need for isolation of pneumonic-plague patients being urgent, permanent isolation hospitals should be available. Such isolation hospitals should admit of individual isolation, be of rat-proof construction, and be capable of easy disinfection. In the grounds of such isolation hospitals ample space should be provided for the construction of additional emergency wards, for which purpose the site should be prepared and foundations laid. The provision of ample air, space and light is desirable.

2. "The hospital accommodation for suspected cases of plague should be adjacent to the hospital for plague cases, and the need for individual isolation being specially important, in order to prevent the infection of non-infected suspects, a separate room should be provided for such patient. No patient should be transferred from the suspect hospital to the plague hospital until a positive diagnosis of plague has been made.

3. "Contact quarantine stations should be so constructed and managed as to secure early detection of cases of plague and, as far as



possible, individual separation ; and the same principles should apply to the construction and management of segregation stations for certain classes of the community and for immigrants.

4. "The best system would be the cubical box system."

One of the results of this Conference, therefore, was the recommendation of the erection of a Hospital, on the most approved of modern lines, for the treatment of plague cases, and the scientific accommodation and isolation of "suspects" and "contacts." To carry out the recommendations of the International Plague Conference, the then Viceroy of the Three Eastern Provinces, H. E. Chao-erh-sun, voted the sum of 50,000 Haikwan Taels (65,000 Roubles), for the construction and adequate equipment of a Hospital at Fuchiatien on the lines suggested by the Conference.

Plans for the Hospital were drawn by Mr Thomas, a member of the Chinese Customs staff at Harbin, according to the suggestions of the Conference, and a contract was entered into with the builders for a sum of 50,000 Roubles.

There was considerable difficulty in obtaining a suitable site for the Hospital. It was the intention of those in authority at the time to use the site of the old Disinfecting Station, at the north-east end of Fuchiatien ; and, in addition, to purchase an adjoining piece of land, as the former site was not large enough. The price asked, however, was exorbitant ; so another site had to be obtained. There were some Government sites available, but all these, with one exception, for reasons of being either too low-lying or being not easily accessible, could not be used. Eventually the present site, the one exception referred to above, to the south-east of the town, where the one hundred quarantine railway waggons were situated during the 1910-1911 epidemic, was selected as being most suitable for the purpose. A more elevated position would certainly have been preferred, but the whole of Fuchiatien is very low-lying, and is subject to floods during the summer months owing to a rise of water in the Sungari River.

The funds voted for the Hospital were under the control of the Customs Superintendent, the Kirin Taotai, Mr Li Chia Ao, and the construction of the buildings was left under his care, being assisted in the matter at the commencement by Dr Sun Pao Lu, the then Senior Medical Officer at Fuchiatien.

Work on the buildings commenced in September 1911, but had to be discontinued after two months on account of the cold weather. With the arrival of the spring of 1912, a start was made on the internal

portions of the buildings, the walls and roofs having been completed the year before.

The Hospital buildings cover an area of approximately four acres (24 mu), with a frontage of over 500 feet. These consist of two main blocks:

1. A North Block, covering an area of a little over two acres. This is divided into two equal portions, one intended for a "Suspects" Hospital, and the other for a Plague Hospital. Each portion is subdivided into a small anterior part, with living quarters for the Doctors and their staff, and a large posterior part containing the wards and rooms for those actually attending on the patients. The only communication between the two parts is through a series of rooms specially arranged for the effectual disinfection of those passing through them.

(a) The "Suspects" Hospital has in the anterior part 24 rooms, including the Doctors' living rooms, quarters for the staff, and disinfection rooms; while in the posterior part, there are ten rooms for attendants and two blocks for use as wards, arranged one behind the other with an open space intervening. Each ward measures 98 ft. 9 ins. long and 19 ft. 3 ins. broad, and is so constructed that every patient is separated from those next him by a wooden partition six feet high. There is accommodation for ten "suspects" and one attendant (for whom a room is reserved in the middle of the ward), all the rooms or cubicles opening into a corridor that runs the whole length of the ward. This arrangement is made to ensure complete isolation of suspected cases. To each cubicle on the corridor side there is an observation window 1 foot square, for the use of the ward attendant.

(b) The Plague Hospital has in the anterior part 18 rooms for the medical officers, their staff, and for disinfection purposes. The posterior part of this Hospital has six rooms for attendants, and three blocks for use as wards. Of these, the foremost, measuring 99 ft. 7 ins. long and 19 ft. 3 ins. broad, is divided into ten compartments or cubicles, separated by wooden partitions six feet high similar to those in the "suspects" ward, with an eleventh compartment in the middle for a ward attendant. This block has observation windows to each cubicle similar to those in the "Suspects" Hospital. The two other blocks, each measuring 89 ft. 4 ins. long and 19 ft. 3 ins. broad, are subdivided into three portions, two for patients, and a third, situated nearest the side entrance and much smaller than the others, intended for a ward attendant. The partitions in this case reach the ceiling.



Each block is built to accommodate at least ten plague cases. On the wall of each of these wards adjoining the corridor, there are two small windows, 2 ft.  $\times$  1 ft., for observation purposes. It will be noticed that in the last two blocks there are no separate cubicles.

2. A South Block, which covers an area of almost exactly  $1\frac{3}{4}$  acres. It is intended for use as a Quarantine Hospital and Disinfection Station. This is also subdivided into two portions.

(a) The anterior portion of the Quarantine or South Block consists of a large compound surrounded:

(i) On the side nearest the road, by a series of nine rooms, which are being used as quarters for the Resident Medical Officer, the Dispenser, dresser, nurses, and clerk. A room in this series will be reserved for use as an Office or Board room.

(ii) On the side opposite to the above, by the first three Quarantine wards which will be equipped for the accommodation and treatment of in-patients.

(iii) On the north side, by a series of rooms, three of which are at present utilised for the treatment of out-patients. On this side also are the Dispensary and Drug Store. At the end of this series, nearest the gate, are rooms intended for the police that have been detailed for special duty at the Hospital, and for the gate-keeper. At the other end is situated the Ambulance shed.

(iv) On the south side, by a series which consists of a set of disinfection rooms,—a detailed description of which follows,—two rooms set aside for a Bacteriological laboratory, and a large store-room.

#### *Disinfection Rooms:*

The disinfection rooms consist of a series of five inter-communicating rooms. The medical officers, on their return from inspection duty, gain entry by a door on the south wall, into

*Room No. 1.* Here they divest themselves of their outermost garments and boots. These are then taken by attendants to be disinfected. Provision is here also made for the officers to use an antiseptic gargle. They then proceed into

*Room No. 2.* This room is provided with pegs, shelves, and lockers. Here the officers take off their inner garments and put them away in the spaces allotted to them. Having thus undressed, they enter

*Room No. 3.* Where they have their disinfectant bath. This over, they go on to

*Room No. 4.* And change into their ordinary clothes. They then pass into

*Room No. 5.* Which is arranged as a sitting room, and from there out into the air again without any risk of carrying infection to others.

The outermost garments taken from Room No. 1 by the attendants are, after sterilisation, returned to Room No. 2, where they are ready for the medical officers as soon as they come on duty again.

(b) The posterior portion comprising 13 rooms, large and small, for attendants etc., together with six blocks arranged on the pavilion system, larger and higher than those in the North Block, three in front, and three behind.

Table showing No. of Rooms, Accommodation, etc. in Harbin Hospital.

North Block				No. of rooms	No. of Wards		
“Suspects” Hospital	{	Anterior portion		24	Nil		
		Posterior portion		10	2		
“Plague” Hospital	{	Anterior portion		18	Nil		
		Posterior portion		6	3		
South Block							
“Quarantine” Hospital and Disinfection Station	{	Anterior portion		29	Nil		
		Posterior portion		13	6		
		Measurement, in feet			Remarks		
		L.	W.	H.		No. of windows	Accommo- dation
“Suspects” Hospital—							
Ward No. 1		98·9	19·3	14·10	14	10	Extra room for attendant.
„ 2		98·9	19·3	14·10	13	10	Do. Cubicles in both.
“Plague” Hospital—							
Ward No. 1		99·7	19·3	14·10	13	10	Cubicles. Room for attendant.
„ 2		89·4	19·3	14·6	10	10	No cubicles. Do.
„ 3		89·4	19·3	14·6	10	10	Do. Do.
“Quarantine” Hospital—							
Ward No. 1	{	84·9	34·8	22·6	21	32	Each block has 4 wards, 2 on either side of corridor, 5' 10" wide.
„ 2						32	
„ 3						32	
„ 4	{	73·0	24·9	17·8	{ 18 16 18	32	No central corridor.
„ 5						32	
„ 6						32	
10 side rooms, various sizes.						50	

The wards in front are each  $84\frac{3}{4}$  feet by  $34\frac{1}{2}$  feet, with doors at either end opening into a long corridor measuring nearly six feet wide. Each ward is subdivided into four equal parts, each capable of accommodating at least eight patients. These wards are heated by the usual Russian stoves. Each block therefore has accommodation for at least 32 patients. The blocks behind are smaller, being only 73 feet by  $24\frac{3}{4}$  ft. These are capable also of accommodating 32 patients. On the wings there are large rooms, four on the north side and nine on the south, capable of holding at least 50 persons.



In the Hospital all the windows are double, this arrangement being necessary owing to the intense cold during the winter.

From the above description it will be seen that in the "suspects" block there is room for at least 20 cases; in the "plague" block there is room for at least 30 cases; and in the "quarantine" block there is room for at least 242 cases. But if the necessity should arise, accommodation could easily be found for many more in the existing buildings; while still more room could be obtained by the erection of temporary sheds in the vacant space available.

Ordinary hospital work was commenced at Fuchiatien after the epidemic of Pneumonic plague, patients being treated at the old Disinfecting Station under the charge of Dr Sun Pao Lu until November 1911, when Dr Sun was transferred to Pukuei. From that date until February 17th, 1912, Dr S. P. Chen took over the duties of Senior Medical Officer to the Hospital.

On account of the lack of funds brought on by the Revolution the Hospital was closed by order of the Taotai on the last day of the Chinese year, February 17th, 1912.

A scheme for the establishment of a North Manchurian Plague Prevention Service had already been sanctioned by the Wai wu pu and the Viceroy of the Three Eastern Provinces before the outbreak of the Revolution; but, owing to the pressure of other business there was considerable delay, so that when the Revolution broke out, the scheme was held back indefinitely.

With the Revolution and the resulting hypothecation of the Customs revenue to the payment of Loans and the Boxer Indemnity, it was impossible to obtain the necessary funds for carrying through such a scheme as the Plague Prevention Service. The only course open was for the authorities to approach the Diplomatic Corps in Peking and obtain their consent to the withdrawal of the amount required for the purposes of the Service. This consent was ultimately obtained in September 1912, and the new service started under the name of the "North Manchurian Plague Prevention Service."

The Hospital was opened for the treatment of general patients on December 16th, the interval having been spent on organisation and preparation. The number of patients attending the out-patient Department has been considerable and is daily increasing.

Vaccination against small-pox is also performed at the Hospital twice weekly, free of charge.

## XI. FIRST REPORT OF THE HARBIN HOSPITAL.

(DEC. 16TH, 1912—MARCH 31ST, 1913.)

BY S. P. CH'EN, B.A., M.B., B.C. (CANTAB.).

### 1. *The opening.*

The Hospital was opened for the treatment of out-patients on December 16th, 1912. I had been ordered to proceed to Taichi, near Changchunling, to investigate into certain alleged cases of plague, and was unable on that account to be present at the opening.

### 2. *Attendance.*

The attendance at the commencement was very small, due no doubt to the fact that the majority of the people had not seen the notices that had been published to announce the opening of the institution. Now, however, the number of patients is increasing daily, and it is notable that the better classes are included among those that attend every morning in the out-patient rooms. These facts show in an unmistakable way that the Hospital has been the means of supplying a long-felt want.

The numbers treated and the nature of the ailments encountered will be seen from the accompanying table. As the table shows a few patients have been attended at their homes.

The greatest number comprise cases of a surgical nature. Among the medical cases the majority consists of affections of the respiratory system. The climate and the general conditions under which the poorer classes live during the winter,—insufficiently fed and insufficiently clad,—will suffice to explain the preponderance of lung cases. It is also not surprising that the cases of venereal disease form an unusually high percentage of the number of patients treated, there being no laws to regulate the management of brothels in Fuchiatien.



3. *Drugs used.*

The amount of money spent on drugs and dressings is as follows :

Initial Purchases	...	Rs. 131.53
Purchases during Jan. & Feb. 1913	...	„ 46.95
„ „ March ...	...	„ 55.13
Total Purchases...	...	„ 233.61
31 lbs. Cotton wool left over from 1910-11	...	„ 24.80
		Rs. 258.41
Less value of drugs etc. remaining	...	„ 91.31
Total expenditure on drugs and dressings		„ 167.10

4. *Fuel.*

The Russian stoves with which most of the rooms in the portion of the Hospital utilised for the treatment of out-patients are supplied have not been satisfactory owing to faulty construction. It has therefore been found necessary to dispense with them altogether and to make use of the small iron stoves left over from the winter of 1910-1911. By this means it has been possible to heat the rooms with a minimum of fuel.

Most of the stoves burn wood : for the rest coal is used. A check is made on the wood-supply by counting the number of pieces bought, and allowing a definite daily supply for each stove. The sum expended on fuel for the period covered by this report is given below :

	1912	1913			
	Dec. 16-31	January	February	March	Total
Wood	Rs. 70.50	70.50	70.50	42.00	253.50
Coal	Rs. 10.05	18.00	19.35	20.00	67.40
Total Expenditure on Fuel—Roubles 320.90.					

5. *The Staff.*

The entire staff at the commencement consisted of :

- 2 Medical Officers,
- 1 Dispenser,
- 1 Apprentice dresser,
- 5 Attendants,
- 1 Cook, and
- 2 Coolies.

At the end of February, owing to the large increase in the number of surgical cases, it was found necessary to employ another apprentice dresser. Thus at the time of writing, the staff consists of :

- 2 Medical Officers,
- 1 Dispenser,
- 2 Apprentice dressers,
- 5 Attendants,
- 1 Cook, and
- 2 Coolies.

In addition, we have two police who have been detailed off for special duty at the Hospital.

6. *Vaccination.*

At the beginning of March notices were issued informing the officials and public of the arrangements that had been made for free vaccination against small-pox. Wednesday and Saturday mornings, between 9 and 10, have been reserved for this purpose, commencing on Wednesday, March 19th.

The number vaccinated up to March 31st is 4.

S. P. CHEN, B.A., M.B., B.C. (Cantab.),

*Senior Medical Officer.*



## XII. MEMORANDUM ON THE METHOD OF KEEPING THE ACCOUNTS OF THE NORTH MANCHURIAN PLAGUE PREVENTION SERVICE.

BY W. HAINES WATSON,

*Formerly Commissioner of Customs, Harbin.*

The chief object aimed at in the present system is simplicity combined with the ordinary essentials necessary for the proper rendering of Accounts quarterly. The manner of keeping the Customs Accounts has been adhered to as much as possible and it is purely in the matter of simplifying procedure that the Plague Prevention Service Accounts differ slightly.

(a) A daily Cash Book records the receipts and payments as they are made. This Cash Book is so arranged that an Abstract Account is kept at the same time, so that at any moment, the sums received and expended under any heading can be ascertained. Payments and receipts are supported by vouchers and at the end of the quarter these vouchers are collected and placed under their special Schedules, and the total of these Schedules will agree with the totals shown under the same heading in the Cash Book and in the Quarterly Abstract Account sent up with that of the Accountant each quarter. The balance held to credit at the end of each quarter as shown in the Cash Book and the Quarterly Abstract Account is accounted for by a certificate signed by the Bank. This certificate supports a statement of balance made out by the Accountant each quarter and attached to the Accounts to show the distribution of funds at the end of each quarter. The balance shown also includes advances which the purchase of articles at home renders necessary, it being impossible to bring such purchases to account until the real expenditure is known. This system of advances is the same as pertains in the Customs Accounts and is simple in the extreme to render. To each Quarter's Account is attached an Advance Schedule

which besides showing the amount of advances outstanding from the previous quarter gives details of advances made during the current quarter. When the necessary vouchers are received, advances are repaid by entries on the same Schedule (these entries being supported by vouchers which are attached to their proper Schedules), the sum total for which being deducted from the amount shown to be advanced gives the total of advances outstanding. Both payment and receipt vouchers should show clearly and in concise language the nature and for what purpose disbursements and receipts are made. They should also show to whom the amounts were paid or from whom received as the case may be. Schedules when made up at the end of the quarter, being simply indexes of the supporting vouchers, the different items appearing on them can be made in the fewest words possible.

(b) Payments are made by the Commissioner of Customs, in his capacity of Treasurer of Plague Prevention Service moneys, on the authority of Demands made out by the different authorised doctors and approved by the Chief Medical Officer. These Demands are numbered by each doctor in sequence, and for possible future reference the number should appear in its place in the final payment voucher. Care should be taken to keep these demand forms up to date and they should be filed separately by the Accountant so that at any moment the cost of maintenance of any particular department or hospital can be seen. No payment should be made by the Treasurer without the authority of properly signed demand forms. At the end of each financial year an abstract should appear in the Cash Book showing the actual cost of each establishment, the totals of which should agree with the demand form amounts as approved by the Chief Medical Officer. These demand forms can then be bound up, in separate covers for each establishment, and archived in the Accountant's office.

(Sgd.) W. HAINES WATSON,  
*Lay Director and Treasurer.*

HARBIN, 25th April 1913.



## XIII. LAHASUSU AND ITS HOSPITAL.

BY THE DIRECTOR AND DR C. H. LUK CHUN HSUAN.

(With Plate XX.)

I. *Position.*

Lahasusu (Lt.  $47^{\circ} 42' N$ ; Lg.  $132^{\circ} 0' E$ ) is a small village situated on the southern or right bank of the River Sungari, about three miles before it winds round to join the Amur. It is hence an important Customs Station for the Chinese Government, watching trading vessels, Chinese and Russian, plying on the river between Harbin and Blagovestchensk on one side and Habarovsk on the other. The distance of Lahasusu from Harbin is 450 miles or 630 versts. Whilst the river is open for traffic from April to the end of October steamers ply regularly between the two ports, calling at Sansing (300 versts from Harbin) and other stations, on an average of one a day. Within the first week of November the river is usually frozen and steamer traffic ceases, the ships being then berthed on the banks wherever convenient during the winter months. Travelling is then accomplished by sledges and carts between the village and Mikailo Seminovskaia situated 30 versts away on the left bank of the Amur. This journey consists of a drive of 10 versts directly northwards from Lahasusu when a small Tartar village called Monhoko is reached, and a further journey of 20 versts, including crossing of the River Amur which occupies nearly two hours. The journey from Lahasusu to Mikailo Seminovskaia usually takes 5–6 hours on the ice, the crossing of the Amur being at places very difficult owing to the large blocks of sharp ice jutting out at every corner, and (in the early months of the closing of the river) thinness of the ice. From Mikailo Seminovskaia to Habarovsk is 242 versts, the frozen Amur having to be crossed once again to reach the latter city situated on the right bank of the river. Here the path is more regular and properly marked out by flags and poles. On the Chinese side of the Amur, *i.e.* the right bank, as far as the River Ussuri, there is no regular post route. Otherwise matters would be simplified, as no delay would then be caused by waiting for the river to get frozen.

The Customs collection at Lahasusu is small, averaging about 2500 Roubles yearly for the last four years since its opening in July 1909. The River Sungari at this point is about 1400 feet wide, and its depth varies from three feet in late autumn to 15 feet or more in May—June.

## II. *The Village.*

Lahasusu is derived from a name given to the place by some Fish-Skin Tartars, known locally by the name of Ho Che in Chinese, "goldi" in Russian, who settled here about the beginning of the Ta Ching Dynasty. "Laha" means straw-and-mud, and "Susu" means a camp. The reason lies probably in the fact that the first visitors,—some fisher folk whose homes were originally situated in the neighbourhood of Habarovsk (Po Li),—saw the remains of some huts made of straw and mud at a place which had served as a camping ground for some of the soldiers of the Manchu Emperor Nurhachu and his successors. A further description of these Tartars will be given under a separate heading.

The village may really be divided into two parts :

A. *The so-called Railway Settlement*, occupying a narrow strip of river frontage varying from 350 feet on the east to 450 feet on the west, for a distance of 4000 feet (about  $1\frac{1}{4}$  versts) and running from the eastern boundary of the residential part of the village to the east where the Hospital now stands. This frontage is yearly diminishing in size owing to the heavy wash of the tide. This zone was mapped out by the Chinese Eastern Railway for its use, and its steamers ply regularly between Harbin, Blagovestchensk and Habarovsk in summer. There are very few buildings now left belonging to the Russian authorities. The remains of the former Russian Customs House still exist, but are uninhabited. The former residential quarters of the Russian officer of a small detachment of 25 men are also unoccupied, he having left last summer. One of the buildings is now occupied by the Chinese Telegraph Office.

The Chinese Customs Lamp and Beacon (No. 381) are also situated here, and in front of them is the anchorage for steamers.

Immediately behind the Telegraph Office, on Chinese ground, is the Chinese Customs House enclosed by a lot of vacant land. The Customs are in charge of an Assistant during the summer months and a Tide-waiter in the winter. The hospital is situated at the bend of the Sungari before it joins the Amur, a good view of the Khingan



Mountain-range being obtainable from the top of the doctor's two-storied residence. The Hospital adjoins the Russian Cemetery, which marks the eastern limit of the Railway area.

Behind the Customs station is the Prefect's Yamen. This was formerly a Chow (lin Chiang chow) and has only become a prefecture since 1909. The area administered is roughly 25,000 square li, including 20 small villages.

B. *The Chinese Residential Quarter* consists of mud houses numbering about 70, and containing 500 people including seven Tartar families.

The people are petty traders in raw skins, game, tinned goods, fish, fire-wood, and spirits. Considerable quantities of spirit are smuggled across the Amur when the river becomes frozen.

The two principal merchants are Fang and Ivan Liu.

There is a school opened by the Government, containing over 40 students 18 of whom are Tartars. The teacher in charge at the time of my visit was Mr Li Lu Chiao.

### III. *The Hospital.*

When it was decided to establish Plague Prevention Stations in North Manchuria in order to prevent a recurrence of an epidemic like that of 1910-1911, Lahasusu was one of the five chosen, although it had never been visited by the plague. The main reason lies in the fact that it is an important calling station lying at the junction of the Amur and Sungari. In April 1911 the Chinese and Russian authorities agreed to send medical expeditions conjointly to the Sungari and Amur regions to inquire into the existence of plague, and incidentally to enforce quarantine restrictions on vessels plying along those rivers. As a result the Customs Commissioner, after consultation with the Wai Wu Pu, despatched Dr W. Kirk to Lahasusu to examine the vessels calling at that place, and the Russian Railway authorities were invited to co-operate in this work. The latter therefore despatched a steamer to Lahasusu, fitted up as a hospital-ship, in charge of a medical man and two female nurses, in order to guard against the possible spread of infection into Russian territory lying further east. Plans were at the same time made for the construction of an Isolation Hospital at Lahasusu and a sum of Rs. 20,000 was voted by the Viceroy of Manchuria with the approval of Wai Wu Pu for the purpose, the money to come from the Harbin Customs Revenue.





Lahasusu Hospital. Nov. 1912.



The Town of Sansing on the River Sungari. Oct. 1912.





The site was chosen after consultation with the Prefect Mr Chu Shou Ching who bought the land, measuring about ten mu, for Rs. 682.58. The site is a good one, being situated on high ground just at the curve of the Sungari before it joins the Amur and two-thirds of a mile distant from the village. Dr Kirk superintended the building operations, and Dr C. H. Luk was appointed as his assistant after Dr Young (of Canton) had left.

In June 1911 the Chinese and Russian Governments rescinded the Quarantine Regulations in force on the frontier between China and Russia, and the Russian hospital staff, who had been living on their ship, therefore left Lahasusu about June 15th.

Dr Kirk remained in Lahasusu from July till September 1911, when he left for Harbin. Dr Luk took charge from June 9th, 1911.

The contract for the building of the hospital was Rs. 18,757. Before completing his work the contractor absconded after a sum of Rs. 95,650 had been drawn by him, and in May 1912 the new Prefect Mr Lin Chang Chih volunteered to complete it for the sum of Rs. 1850. At the time of my first visit, October 25th, 1912, the buildings were not yet dry. The plastering everywhere was poor, and the stoves were not well made.

However, Dr Luk moved to his new quarters at the beginning of October and since then has been treating patients at the Hospital.

The Hospital consists of the following:

(a) A two-storied block in the centre for the medical officer. There are 16 windows (all double); on the ground floor are four rooms, a dispensary, a waiting room, a consulting room and a laboratory; the top floor is divided into four rooms for the private use of the medical officer. The servants' quarters consisting of a small block of four rooms lie immediately behind the above.

(b) Behind and on the western side are two blocks:—(1) for plague cases, (2) for "suspect" cases. Each block contains 12 compartments, each  $8 \times 12$ , with a side corridor. These compartments are separated from one another by wooden partitions 6 feet high. Each compartment has a separate double window, so that there is abundance of light. Both the plague and "suspect" wards are built alike.

(c) On the eastern side are two more blocks for quarantine purposes. These are almost square buildings, each with two doors and 12 windows. Each block is divided into two large wards with a passage in the middle. Each ward is able to accommodate ten persons. All the buildings have plank floors. The following table indicates the measurements:



*Lahasusu and its Hospital*

	Doctor's Residence	Plague and Suspect Blocks (each)	Quarantine Blocks (each)
Length in feet	32	69	$34\frac{1}{2}$
Breadth in feet	28	$21\frac{1}{4}$	32
No. of wards	8 rooms	12 rooms	2
Size of each ward	—	$5\frac{1}{2} \times 11\frac{1}{2}$ ft.	$11\frac{1}{2} \times 26$ ft.
No. of windows	16	12	12

The Hospital is perhaps the finest and most prominent building ever built at Lahasusu, and commands a fine view of the two rivers—Sungari and Amur. Vessels going to and from Lahasusu pass it before reaching the village.

## XIV. THE FISH SKIN TARTARS.

BY DR WU LE TEH.

(With Plate XXI.)

Chinese, Ho Che or Yu P'i Ta Tzu.

Russian, Goldi, *i.e.* native.

So called from their using the skin of fish (principally tamara salmon) for making clothes, slippers, caps, etc.

*Place of Abode.*

Their original home is probably Habarovsk, from which place they travel in their small canoes up and down the rivers Amur, Ussuri, Sungari, Harka, in search of fish and animals. They are nowadays to be found in the regions bordering on the cities of Habarovsk, Nikolsk, Lahasusu, Sansing, and occasionally Blagovestchensk.

*Origin.*

The Ho Che or Ta Tzu probably belong to a branch of the Tartar race, and are descendants of the Kin family that reigned from 1115-1234 A.D. and was one of the three Tartar Dynasties. In Chien Lung's reign these Tartars were recognised as part of the Manchu family and therefore enjoyed the privileges of that race. Their language and writing are both Manchu and I have seen their women poring over books printed in upright Manchu characters. There is little doubt that they were once spread widely over this part of Manchuria, frequently visiting Sansing, which they regarded as the capital and the centre of civilization. Their numbers have shrunk considerably since the advent of Chinese and Russians, and large numbers were killed during the constant invasions of Russians and Chinese soldiers in the seventeenth and early part of the nineteenth centuries.



*Features.*

The Ho Che are markedly Mongolian in features, the malar bones being particularly prominent, and the eyes drawn outwards and upwards. The frontal eminence is good, and the hair usually brown. The men wear queues, though at the time of my visit, the local headman, called the Emperor, had had his removed. In some parts where they have not come into contact much with the Chinese, they do not shave their heads but dress their long hair like Koreans.

The women are not big, their feet are not compressed, and they dress like Manchus. Their hands are neat and small and they are domestic in their habits. Men and women smoke long Chinese pipes and Manchurian tobacco.

*Characteristics.*

The average number of children in each family is three. The children are free and play about much in the open air. They look healthy. The babies, when born, are placed on a boat-shaped piece of board, which can swing backwards and forwards. Over the centre is a curved piece for moving the "bed" from place to place. They are nursed by their mothers up to two years of age. If there are no other children weaning is left till an even later period.

In winter both men and women dress in the furs of antelope, goat, sheep, and wear a peculiar kind of slippers made of skin slipped over padded socks, for walking on ice. These peculiar fish-skin slippers break easily but give a firm hold on the ice. Occasionally cowhide shoes or Wu-la imported from Sansing are seen. They sleep on Chinese kang. The household requisites, *e.g.* drawers, bedding, food, are mostly made after the Chinese style. Formerly they fed on fish and animals caught (they consume even the flesh of the wolf, otter, or hao), but lately they have added millet and wheat to their dietary.

The women seem to be equal in number to the men. They do much work at home, whilst the men go out fishing. The women have recently intermarried a great deal with Chinese, their offspring not showing such marked facial peculiarities. These I have seen at school and also amongst the Prefect's soldiers. Their homes are like Chinese huts, simply arranged, neater than Chinese houses of the same grade, but still not very clean. They place their skins and important belongings in a small





Fish-skin Tartar Families.



Fish-skin Tartar Boys at School. Lahasusu, 1912.





rectangular hut built on four poles about 6 ft. from the ground. Just where the poles meet the floor of this hut are four empty kerosene tins, which cause a scratching noise whenever any wolf or other animal attempts to climb up.

*Occupation.*

They fish mostly. The hooks they use have no barbed ends and are simple plain hooks attached by means of a short string to a light piece of wood. The fish snatches at the wood floating on the water and gets caught by the hook which is lying close by. Each hook measures  $1\frac{1}{2}$  inches long.

Enormous numbers of fish are caught yearly in the Sungari; the principal varieties are:

Hsun Huang Yu (sturgeon).

Tamaha Yu (tamara salmon).

So Yu, *Mugil so-iuy* Basil.

Tao Yu, *Coilia nassus* Schleg.

Lien Yu, *Silurus asotus* L.

Li Yu, *Cyprinus carpio* L.

Shan Yu, *Anguilla bostoniensis*, Les.

Pai Yu, *Culter erythropterus* Basil.

Chien Tou Yu or Chia Chi Yu, *Platycephalus cultellatus*, Gunther.

Chelo Yu.

Hsilin Yu.

Kou Yu.

Of these, the best eating are the sturgeon, salmon, chelo and pai-yu.

The Tartars live peaceably with the Chinese and seldom use the rifle. One of their leaders living at Lahasusu, called Sansing Chai, a young man of thirty, is remarkably modern, having no queue and wearing clothes cut after the most approved Shanghai fashion. He speaks Chinese, Russian, as well as his own dialect, and writes Chinese. He possesses a gun and has acted as interpreter to the Magistrate at Hulin. He owns landed property which he rents out to Chinese for cultivation.

*General and Scientific.*

The girls menstruate at the age of 15 years. The people are strong in physique though as a rule short in stature. The tallest man I have seen is under 5 ft. 9 in. They appear to age quickly, especially the women. The Tartars are, like most disappearing races, subject to



periodical epidemics of small-pox. Last year 80 out of a small community of 300 died in a few weeks. The natives follow the ancient Chinese system of medicine, use plenty of herbs for ailments, but they gladly welcome vaccination. They have never known the practice of inoculation for small-pox as done by Chinese. They also believe in witch doctors, and build small open-air shrines to the gods of health and the mountains (spirit of tiger). I have seen advanced tuberculosis of the lungs of three years' duration in a young man, with fever, cavitation and crepitations in both lungs. Women often come to hospital complaining of Amenorrhoea. All girls marry. It is quite possible that the moral code among them is not rigid, for lodgers are taken freely into the apartments of families where the women reside.

## XV. REPORT ON INVESTIGATIONS AT TAI CHI.

BY S. P. CH'EN, B.A., M.B., B.C. (CANTAB.).

I left Harbin, with Ch'ang Hsi Tseng and Liu Fu Ch'en (servant), on Sunday, December 15th, at 3 p.m., arriving at T'aolaichiao Station at 7.30 p.m. We were met at the latter station by one of Mr Zagorski's men, from whom we ascertained that there was only a rumour about in T'aolaichiao that there had been several cases of Plague at Tai chi. We could not obtain any further information on the subject in question, so I decided to spend the night at T'aolaichiao, and to proceed to Tai chi at dawn next day.

At 6 a.m. on Monday, December 16th, as soon as it was possible to see our way, we started for our destination. The first village of any size was San chia tzu, about 30 li from T'aolaichiao. At 12.15 p.m. we arrived at Chie ch'ang, 120 li from T'aolaichiao. Upon enquiry we learned that there were about 100 families in this place, with a Hsun ching chu and a Tzu chih hui. We also learned that there was no disease in this village.

After resting and feeding our ponies, we left Chie ch'ang at 2 p.m. We made Ch'ang ch'un ling, 170-180 li from T'aolaichiao at 5 p.m., and continuing our journey in the darkness, arrived at our destination, Tai chi, which is another 10-12 li farther, at 6.15 p.m.

Tai chi is thus about 180 li from T'aolaichiao, in a north-westerly direction. The nearest large town is Hsin ch'eng fu, the latter being about 120 li away. Shuang ch'eng p'u and T'aolaichiao are equidistant from Tai chi.

Tai chi is a village situated on the south bank of the Sungari, and is subdivided into Shang Tai and Hsia Tai. The village really covers a large area in comparison with the number of inhabitants, as the houses are so scattered. There are about 800 families in the whole village, including about 20 Mongol families. The majority of the people are farmers, even the Mongols who speak Chinese, having a



similar occupation. Some of the villagers earn their living by cutting wood on the opposite side of the river (Chiang pei), while a few others are fishermen.

On Tuesday morning I was taken to the house in which the cases of plague were said to have occurred. The house was situated in a compound near the river, there being three other houses in the same compound. Within this area there now live 19 people, 13 of whom belong to one family, Kwoa kuang li being the head, while the remaining six belong to a T'ao family who have rented one of the huts in the compound. Three of the Kwoa family, all men aged 35, 28 and 26, lived, and are now living, in the same room where the alleged plague cases had died. The room in question is about  $24 \times 15$  feet, with another room adjoining  $24 \times 30$  feet, which has two large k'angs on either side, intended for use as an inn.

At this house three men had died.

1. Kwoa Lien Ch'ing, age 40, native of Shantung (Ch'ingchoufu). Occupation, wood-cutting on the farther side of the river. He was brought back from across the river on the 15th of the 9th moon (Oct. 24th), was not able to walk. The symptoms he had complained of were severe abdominal pain and vomiting. There was no cough or spitting of blood-stained sputum. He had been ill for four or five days before being brought back. He died on the 16th (Oct. 25th).

2. Fu T'ing Chung, age 38, Yenchowfu man, no fixed occupation. Was taken ill on the 16th of the 9th moon (Oct. 25th). Symptoms were vomiting and diarrhoea, with headache as well. There was also no cough or blood-spitting. He was able to get about during his illness. He died on the 24th of the 9th moon (Nov. 2nd).

3. Fu T'ing K'e, age 30, younger brother of No. 2. Occupation, wood-cutter. He left Tai chi for the opposite side of the river with a sore on the left shoulder. Returned after three days on the 13th of the 10th moon (Nov. 21st) with the whole of the left arm, forearm, and hand inflamed and swollen. The left side of his chest was also affected. He died on the 23rd of the 10th moon (Dec. 1st).

Two men left this house which was used as an inn for wood-cutters and fishermen. One of them was:

4. Kwoa Ch'ing Lin, age 40, head fisherman. He was taken ill on the 22nd of the 9th moon (Oct. 31st) at the inn in question. He left the inn on the 25th, and went back to his own place in Ch'ang ch'un ling and died there. No further information with regard to his illness could be obtained except that 20 days afterwards his wife died. The

explanation given by the informers was that he had left debts unsettled, and that these brought on the death of his wife. An infant of a few months old died after its mother, as it was left without care. There were in the same house two grown-up sons and one daughter, and these are still living.

The other was :

5. Fan Ching Shun, age 59, native, occupation, fisherman. He was taken ill at the above inn on the 13th of the 9th moon (Oct. 22nd), and after two days' illness went to another house, belonging to a Chang family, about two li from the inn. On arrival at the house he complained of feeling extremely cold, headache, and general pain all over the body. There were no signs of cough or of blood-spitting. He died on the 16th (Oct. 25th).

In the same house, which is a small one, there were and still are two men, two women, and four children, all of whom have been in the best of health since.

The sixth death in Hsia Tai about this period was the wife of a carpenter named Pao. She was taken ill on the 17th of the 10th moon (Nov. 25th), and died after ten days. She had no cough nor any other symptoms pointing to plague. She lived with her husband and a four year old son, in a compound in which there were four other houses. Since her death the husband and child have moved to a place called Wu t'oa, and there has not been any illness there since their arrival. Nor has there been any illness in the house next door, there being a family of six in it, all of whom are well. In another house in the same compound, there is a family of three, by name Ch'en, also all quite well at the time I saw them.

The seventh death in Hsia Tai, about this time, was that of a native farmer named Chang Hai, aged 43. His illness began on the 4th day of the 10th moon (Nov. 12th). His symptoms were generally pain in the body and headache. There was also no cough. He went to a Lama temple close by, and had a dose of medicine given him. He died on the 7th. At the time of his illness he was staying with a family of seven, three males, one female, and three children. These are quite well and healthy. He had a wife and two sons. They moved to the grandparents' house after the father's death, and are also well. There has not been any illness in the Lama temple.

The two Russians belonging to Mr Zagorski's establishment, from whom the report about plague had emanated, and who were said to be ill at the time, are both quite well and healthy. I stayed in the same



house as the latter. Mr Zagorski, who was our host, informed me that he was away at the time the report was made.

On Tuesday, Dec. 17th, after making investigations at Tai chi, I proceeded to Ch'ang ch'un ling to see the authorities there. I went to the Tzu chih hui first, but the official in charge was not in. His assistant informed me that the health of the town was normal. From here I went to the Hsun ching chu (Police). The chief official was also out. From his assistant I obtained the following information:

The jurisdiction of the Ch'ang ch'un ling officials extends over an area of 100 li from east to west, and 50 li from north to south. In this area there are 262 tuns, with 2164 private houses, and 5687 houses rented out. The population consists of 23,105 females and 21,045 males. To maintain order in Ch'ang ch'un ling itself, which has about 700 families (all in one locality and not scattered as in Tai chi), there are 56 police, including officers and 18 mounted police (the Chief of police being a native of Chinanfu named Li ching shan); there are also 70 cavalry under the command of Wei ping yin. The main street is wide, and numerous mud walls meet the eye as one proceeds along. The town gives the appearance of health and cleanliness, while the houses are comparatively well-built, and the shops look prosperous, quite unlike the scattered mud huts in Tai chi. The health of the town I was informed left nothing to be desired. All these places are under the jurisdiction of Hsin ch'eng fu (Bedoune). It covers a distance of 400 li, T'aolaichiao being the 6th section, Chie ch'ang the 7th, and Ch'ang ch'un ling the 8th.

During the epidemic of Pneumonic plague in the winter of 1910-11 there were about 40 to 50 deaths altogether within the entire jurisdiction of Ch'ang ch'ung ling, including three deaths at Tai chi. Even this number might have included deaths from natural causes, as the people are not quite sure even now as to what plague really is.

### *Conclusions.*

The natives of the different places visited are quite unaware of the existence of anything bearing a resemblance to plague. They told me that the health of the different districts left nothing to be desired. No cases of illness could be found after careful enquiry, and there was absolutely no material for microscopical investigation.

The deaths at Tai chi were among a class of men who had to undergo the most terrible hardships imaginable in their attempts to

earn a living during the winter. The fishermen I was informed had to go into almost freezing water, and were compelled sometimes to remain submerged as far as the chest for a considerable interval, while the wood-cutters had to expose themselves to conditions and privations of a somewhat similar nature. As is well known these men are generally very inadequately clad and ill-fed.

Had any of the cases been instances of plague, especially of the Pneumonic variety, there would have been many more fatal cases, especially under the existing circumstances, the size of the rooms in which the deaths had taken place, and the mode of living among the inhabitants being unusually favourable for the spread of such an infection as that of Pneumonic plague.

(Signed) S. P. CH'EN, M.B. (Camb.),

*Senior Medical Officer, Harbin.*



## XVI. REGULATIONS CONCERNING THE DUTIES OF MEDICAL OFFICERS, AND THE MANAGEMENT OF HOSPITALS.

### *Hospitals.*

1. The Hospitals in North Manchuria have been established and constructed primarily for the prevention of Plague, and, should the necessity arise, for the isolation and treatment of such cases. Under ordinary circumstances, other cases of infectious disease, and such cases as are usually encountered in hospital practice, may be admitted.

2. Hospitals, instruments and appliances must always be kept absolutely clean and serviceable. Medical officers are responsible for the behaviour of those under them, and for the proper maintenance of discipline and order in the hospital under their care.

3. Rooms and appliances reserved for the accommodation and treatment of patients must not be used by members of the staff; exceptions to this rule may be made after the written sanction of the Chief Medical Officer has been obtained.

4. Should any repairs to buildings, or additions to equipment, or anything else connected with the hospitals, be required, these should be carefully noted down from time to time on the Demand Forms supplied, and sent to the C.M.O.

### *Medical Officers.*

1. Medical Officers are appointed by the Director and Chief Medical Officer whose orders they must obey, and to whom they are responsible for the satisfactory performance of their duties.

2. There are two classes of medical officers:

(a) Senior Medical Officers who are chosen by virtue of having graduated from a recognised European, American, or Japanese University, or by virtue of their being graduates of a Government Medical College of ten years' standing, and having since been in continual medical practice.

(b) Assistant Medical Officers who are chosen from among the graduates of recognised medical schools in China.

In communications, medical officers are addressed as above.

3. It is proposed to station one Senior Medical Officer at Harbin, Manchouli, and Taheiho, and one Assistant Medical Officer at Sansing and Lahasusu. In Harbin there will be stationed an Assistant Medical Officer as well as a Senior Medical Officer. If necessary, Assistant Medical Officers will also be appointed to Manchouli and Taheiho.

When an Assistant Medical Officer is stationed with a Senior Medical Officer, the former is expected to receive his immediate directions from the latter.

4. All medical officers, Senior and Assistant, are expected:

(a) To keep their hospitals in proper working order on all occasions and for all emergencies, and to see that their staff perform their duties efficiently.

(b) To treat patients in a skilful manner.

(c) To make proper entries in a book of all cases treated by them in the way described below. Quarterly reports must be made on forms supplied by the Director and C.M.O., and must include details up to the end of every March, June, September and December. Duplicates of such reports must be kept at the hospital.

(d) To keep accounts according to properly approved forms supplied by the Treasurer. Medical officers, in charge of stations, are responsible for the safe keeping of money entrusted to them, together with all books, vouchers, etc., pertaining to it.

(e) To make proper indents for Drugs and Medical Appliances required by the hospitals in their charge, and to make returns at the end of every quarter of the stock remaining.

(f) To supply on the pay-sheet the names of all the staff, and to hand over their Petty Cash Account Book to the Treasurer at the end of every month.

(g) Not to leave the district in which they are stationed unless with the sanction of the Director and C.M.O., or in his absence from Harbin, of the lay Director and Treasurer.

(h) Not to engage in private practice; but, should their professional services be urgently required, this may be allowed. On no account, however, must the carrying on of such practice interfere with the proper duties of the medical officer at the Hospital.

(i) To attend upon members of the Maritime Customs staff and officers of the Government whenever required free of charge. Unless



seriously incapacitated, lower members of the Government Service (*i.e.* below the rank of Magistrate or Assistant of Customs) are expected to call at the Hospital for treatment.

5. Medical officers are instructed to keep on friendly terms with the local Chinese officials and to seek their advice when necessary. It is also desirable that medical officers should cultivate friendly relations with the foreign authorities and medical colleagues whenever these are present.

6. All reports and accounts submitted to the Director are, for the sake of convenience, to be written in English. The names of persons and places or other doubtful appellations should have their Chinese equivalents in brackets as well.

7. It is intended to establish a museum of medical objects in Harbin, illustrating as far as possible matters of medical and general scientific interest in Manchuria, relating particularly to the origin, distribution, and treatment of plague. Medical officers are requested to co-operate in making this museum a success. All reasonable expenses incurred in the acquirement of suitable specimens will be refunded in full.

8. All Quarterly Reports must be dispatched to the Central Office at Harbin before the 15th of January, April, July and October.

9. In the absence of the Director and C.M.O. from Harbin, the lay Director and Treasurer will take over his duties. In technical matters, the lay Director will be guided by the advice of the Senior Medical Officer at Harbin.

10. Medical officers are expected to be on duty at the hospital on week-days from 10 a.m. to 4 p.m.,—with an interval for tiffin from 1 p.m. to 2.30 p.m.,—except on Saturdays, when working hours are from 10 a.m. to 1 p.m.

11. Medical officers should send to the C.M.O., at least once a month, confidential reports relating to their work, and to the general behaviour, intelligence, willingness to work, etc., of the members of their staff. It is desired that those who show special aptitude and intelligence should be encouraged in their work, and should receive promotion whenever an opportunity occurs. One of the objects of the Service is to train up a new body of men for the foundation, upon a permanent basis, of a properly equipped Chinese Public Health Service.

12. As soon as plague or any epidemic of infectious disease occurs, medical officers must at once telegraph to the C.M.O. and on the same day write giving full particulars of the history, origin, spread (if any),

and any other useful information there may be. No delay whatever should take place in informing the C.M.O. on these points.

13. Medical officers are expected to advise the local authorities regarding the sanitary affairs of the town or district in which they are stationed, especially with respect to the prevention and treatment of infectious disease, street cleaning, refuse removal, and the selling of unwholesome fruit and cold drinks in the summer. Whenever possible, an estimate of the local population should be made, as well as a weekly record of the number of births and deaths.

14. Medical officers are expected to spend their time fruitfully, reading medical books and journals, and collecting rare animals, mosquitoes, fleas, rats and blood- and other parasites of men and animals, and other interesting data.

Specimens should always be marked thus :

Date caught .....  
Where caught.....  
How preserved .....  
Medical Officer .....

Whenever possible, the climatic conditions and the peculiarities of the local people should be studied and reported upon. Reports on interesting scientific facts and observations are always welcome. It is to be borne in mind that the Service is a research as well as an ordinary medical service, and that those who show special aptitude for research work will receive more favourable consideration than others. Detailed descriptions of methods employed for the preparation of specimens will be sent on separate sheets. All specimens are to be forwarded to the C.M.O.

#### *Staff.*

1. The appointment and dismissal of dispensers, dressers, nurses, and clerks, are in the hands of the C.M.O., but, when attached to a hospital, they are under the direct control of the medical officer-in-charge.

2. The number of sanitary attendants and servants at each hospital is fixed by the C.M.O., but their appointment and dismissal will be left to the discretion of the medical officer-in-charge. In all such cases, however, the C.M.O. should be notified.

3. Regulations for the maintenance of discipline among the junior employees of the hospital are to be framed by the medical officer-in-charge subject to the approval of the C.M.O.



*Patients and their Treatment.*

1. All cases treated must be entered in a book provided for the purpose under the following headings:

- (a) Date seen
- (b) Number and Name
- (c) Sex and Age
- (d) Trade or Occupation
- (e) Diagnosis
- (f) Treatment,—only essential medicines being mentioned
- (g) Result
- and (h) Interesting features, if any.

2. Before deciding upon the admission of patients into the hospital the medical officers should see that these are properly recommended by

- (a) some local tradesman of standing
- or (b) some responsible local authority, and that they have a reasonable chance of recovery, if admitted. On no account, however, must a patient be admitted if the case appears hopeless. Cases of an urgent nature may be admitted by medical officers at their discretion. This regulation applies only to ordinary hospital cases when no epidemic exists.

3. When a patient dies in the hospital, the local authorities and those who have recommended him must be informed at once, so that they may look after the funeral arrangements.

4. Medicines and dressings must be used economically, and expensive drugs and materials sparingly, in the treatment of ordinary cases. Opium, morphine, cocaine, and deleterious drugs, should be avoided wherever possible. No charges are to be made for attendance or medicines in the hospital.

Any of the above Regulations may be revised or rescinded at the discretion of the Chief Medical Officer. In such a case, the Medical Officers will be duly notified.

HARBIN, *Jan. 1st*, 1913.

## XVII. FIRST JUNE QUARTER REPORT, 1913.

HARBIN,

12th June 1913.

SIR,

I have the honour to submit the Third Quarterly Report of the North Manchurian Plague Prevention Service. The date is earlier than usual owing to instructions I have received from the Board to proceed to the International Opium Conference at the Hague, and to the International Medical Congress in London.

2. No plague has occurred throughout Manchuria, and the health of the province has been satisfactory.

3. On the departure of Mr W. Haines Watson for Europe on leave Mr R. de Luca, the new Commissioner of Customs in Harbin, took over the duties of Lay Director and Treasurer of the Service from April 16th.

4. The necessary alterations and additions to the Harbin Hospital are nearly complete, and it is hoped that the formal opening will take place at an early date.

5. Dr F. E. Reynolds, a graduate of Edinburgh who had carried out much valuable research work in Bacteriology at Edinburgh, Berlin, and Brussels, was appointed a Senior Medical Officer of the Service. Although he has been gazetted as Senior Medical Officer at Taheiho, he will stay in Harbin and undertake the duties of bacteriologist. He reported arrival on May 2nd.

6. Dr Hwang E, who graduated from the Peiyang Medical College five years ago, was appointed an Assistant Medical Officer of the Service from May 16th.

Dr Lin Yi Te, who graduated from the Union Medical College, Peking, was appointed Assistant Medical Officer at Harbin on May 5th.

7. Mrs Yeh Ch'en Ping Tuan, a graduate of the Nurses' Training College at Foochow, was appointed Sister-in-charge of the Harbin Hospital from May 25th on the recommendation of Dr Hu Kim Eng of Foochow.

Mrs Tsao Feng Hui Ch'ing was appointed Matron in charge of the Harbin Hospital from June 8th.

8. Dr Luk Chun Hsuan, Assistant Medical Officer at Lahasusu, was transferred to Taheiho in the same capacity.



9. I left Harbin on May 24th on a visit of inspection to the different hospitals on the Rivers Sungari and Amur. The steamer on which I travelled was wrecked within fifty miles of Sansing, but after a delay of 24 hours I caught another vessel and reached that port safely on the 27th. I called on the local Taotai and Prefect and also on Mr Chien Hsi En (manager of the Sansing branch of the Kirin Government Bank) who had been instructed by the Governor to purchase the site for the Hospital. I also met the leading merchants and gentry of the neighbourhood, and they all welcomed the idea of our establishing a hospital there. With the help of these gentlemen I was shown over ten possible sites, and finally decided upon a group of buildings situated on high ground in two large compounds enclosed by wooden walls. The whole area measures about 250 feet square, and the purchase price was 35,000 tiao amounting to Roubles 4250. Besides this, a tax of about Roubles 400 as well as another considerable sum will be required for alterations, repairs, and equipment; the total cost will thus come approximately to Roubles 10,000. I have written to the Governor asking for the necessary appropriation. Dr Tang Tsung Nin has been appointed Medical Officer-in-charge of the new Hospital.

10. Whilst at Sansing I received a wire from the Board to proceed to the Hague and attend the Opium Conference which opens on July 1st. I was therefore unable to visit Lahasusu and Taheiho, and instructed Dr Ch'en, Senior Medical Officer at Harbin, to do so on my behalf. Acting on my recommendation the Board has appointed Dr Ch'en Acting Director and Chief Medical Officer during my absence in Europe.

11. Most of the apparatus for the Bacteriological Laboratory has now arrived and is under the control of Dr Reynolds who is continuing the plague investigations begun by me.

12. I have now completed my Report on my researches into the relationship of the Tarbagan to Plague during the last  $2\frac{1}{2}$  years, and will present it before the International Medical Congress to be held in London on August 5th—12th.

I have the honour to be,

Sir,

Your obedient servant,

(Sgd.) WU LIEN-TEH,

*Director and Chief Medical Officer.*

## XVIII. FIRST SEPTEMBER QUARTER REPORT, 1913.

HARBIN,

30th September 1913.

SIR,

I have the honour to submit the Fourth Quarterly Report of the North Manchurian Plague Prevention Service for the period ending September 30th, 1913.

2. I attended the International Opium Conference held at the Hague from July 1st to 7th, as the Government Delegate in conjunction with Dr W. W. Yen, Minister to Germany. After that I proceeded to London and attended the International Medical Congress held there from August 7th to 12th, as Government Delegate, and read my Report on "Investigations into the Relationship of the Tarbagan (Mongolian Marmot) to Plague" before the Tropical Diseases Section. An abstract of this paper has already been published in the *Lancet* of August 23rd, and the full Report with maps and illustrations will appear in the October issue of the *Journal of Hygiene*.

A joint paper by G. Sims Woodhead, Professor of Pathology at Cambridge, and myself entitled "Notes on the Histology of some of the lesions present in Pneumonic Plague" will appear in the *Journal of Pathology and Bacteriology*. This paper will be illustrated by chromographs.

3. Whilst in London I received telegraphic instructions to proceed to America and attend the International Congress of School Hygiene held at Buffalo from August 25th to 30th. The Reports of this Congress and of the London Congress will be submitted to you separately at an early date.

I reached Harbin from America on September 29th.

4. Dr Ch'en Szu Pang, who has been acting as Chief Medical Officer during my absence, left Harbin on June 6th to continue the tour of inspection which was begun by me. He visited Sansing, Lahasusu, and Taheiho, and at the latter place fixed the site for the



Hospital to be established there. The ground was presented to the Service by the Heilungchiang Government.

The cost of the new Hospital buildings, including architect's fee, amounts to Roubles 15,378. This sum is available from the Taheiho Hospital Fund mentioned in Paragraph 7 of my "March Quarterly Report."

Dr Ch'en returned to Harbin on July 17th.

5. I regret to state that the funds promised by the Governor of Kirin for the building and equipment of Sansing Hospital have up to the present not been forthcoming. As it was impossible to cancel the contract already signed, and as the need of a hospital at Sansing was urgent, it was decided to temporarily advance the funds immediately required from the Taheiho Hospital Fund.

6. The formal opening of the Harbin Hospital took place in bright weather on August 27th. A full Report of the proceedings has no doubt been sent by Mr Fu Ch'iang, whom the Board deputed to declare the Hospital open on its behalf. The proceedings were entirely satisfactory.

7. No plague has occurred throughout Manchuria and the health of the province has been satisfactory.

8. Dr Reynolds visited Hailar, Manchoulie, and Mukden between July 20th and September 16th to continue the investigations as mentioned in my First June Quarterly Report. He made interesting observations on the parasites found on the bodies of the Mongolian marmot and on the Gopher, an allied animal living near Mukden.

9. Dr Hwang E, Assistant Medical Officer at Lahasusu, resigned on September 16th. Dr Ts'uei Ch'ang Shan, a graduate of the Union Medical College, Peking, was appointed in his place from September 22nd.

10. Several rumours regarding outbreaks of small-pox and cholera at Ashiho, Hulan, etc., were circulated during the past quarter. Each place was immediately visited by our Medical Officer, who proved the rumours to be unfounded. These frequent reports of outbreaks of epidemic disease show the absolute necessity of the presence of a well-equipped medical staff ready to control any situation that might arise.

11. Whilst in London I took the opportunity of making arrangements with the Cambridge University Press for the publication of the Annual Report of the Service. It is hoped that this will be ready for distribution by November. This Report will contain, in addition to other matter, articles which have been published by the Medical Officers of the Service in the various scientific journals.

12. The large Thresh Disinfector has arrived and has been satisfactorily installed.

13. This being the last Report of the year I beg to acknowledge the hearty cooperation of the Lay Director and Treasurer, and of my medical colleagues and other members of the staff in placing the work of the Service on a firm basis. Much substantial progress has been made in every direction, especially in the awakening of the masses to a proper understanding of modern Public Health measures and the Prevention of Disease.

I have the honour to be,

Sir,

Your obedient servant,

(Sgd.) WU LIEN-TEH,

*Director and Chief Medical Officer.*



## XIX. THE INAUGURATION OF HARBIN HOSPITAL.

(With Plate XXII.)

The Harbin Isolation and Quarantine Hospitals were declared open by the special representative of the Wai Chiao Pu, Mr Fu Ch'iang, on Wednesday, August 27th, 1913. The weather was perfect, and the general conditions were distinctly favourable. The guests, numbering about 150, were received under a large tent in the quadrangle of the Quarantine Block, which had been specially erected for the occasion, there being no room in the whole hospital large enough to accommodate the guests that were expected.

The guests began to arrive a little before 5 p.m., the hour fixed for the commencement of the inaugural proceedings. Those present included: the representative of the Fengtien Government, Dr Lo Yü Fan; the representative of the Kirin Government, Mr Li Chia Ao; the representative of the Heilungchiang Government, Mr Li Hung Mo; the Director of the Bureau for Foreign Affairs, Mr Sung Po Sheng; all the members of the Consular Corps, with the exception of the Consul-General for Russia, Mr Poppe, who was absent through illness; General Horvat, Generals Sivitsky and Volodchenko, and other members of the Chinese Eastern Railway Administration; the Pin Chiang Hsien, Mr Hwang Ch'ing Fen; the representative of the Kuantung Government, Dr Murata; the representative of the Harbin Municipal Council, Mr Dobisoff; medical representatives from the Chinese Eastern Railway Hospital staff and the Red Cross Hospital; the higher Chinese and Russian officials; delegates from the Tzu Chih Hui, Tung Shih Hui, Yi Shih Hui, Shang Wu Hui, and Kung Wu Hui; and correspondents from the Chinese and Russian newspapers.

Owing to the late arrival of some important officials, it was not until 5.45 p.m. that I introduced to the assembly Mr Fu Ch'iang, the special representative of the Wai Chiao Pu. He thereupon delivered his inaugural speech, and declared the Hospital open. After a brief reference to the events leading to the establishment of the

institution, he concluded with the toast of the President which was drunk amid strains of music from a Russian military band.

Mr Li Chia Ao followed next with a general *résumé* of the period between the winter of 1910 and the date of the opening, dwelling chiefly on the good work performed by Dr Wu Lien Teh and Mr Watson, the last Commissioner of Customs in Harbin, in having been the means of originating the Hospital and the Plague Prevention Service. He also laid stress on the kindly assistance rendered by the Chinese Eastern Railway Administration, coupling with it the name of General Horvat. On the conclusion of his discourse the toast of the Tutuh of Kirin was drunk.

The next speakers in succession were Mr Li Hung Mo, Mr Sung Po Sheng, and Dr Lo Yü Fan. All the speeches were delivered in Chinese and were ably translated into French by Mr Chu Yü Ch'en, of the Chinese Eastern Railway Administration.

General Horvat was the first to reply. He made reference to the good work that was being accomplished, the buildings on all sides standing, he said, as evidences to support his statement.

Mr Honda, the Consul-General for Japan, speaking in French on behalf of the Consular Corps, in reply to the toast of Mr Sung, also made some highly complimentary remarks.

Mr Dobisoff, representing the Harbin Municipal Council, said that an institution such as the one that had just then been declared open was bound to be not only of great benefit to Fuchiatien, but that the influence it was destined to exert would also be felt in Harbin.

Baron Budberg, one of the medical officers in the service of the Chinese Eastern Railway, was the next speaker, and echoed some of the sentiments already expressed by previous speakers.

The above speeches, with the exception of that of Mr Honda, were all delivered in the Russian language, and were all translated into Chinese also by Mr Chu Yü Ch'en.

Dr Murata then requested me to read a speech in English on his behalf, the original of which is appended.

After appropriate replies had been made by Mr Fu Ch'iang and Mr Li Chia Ao, and after a vote of thanks to Donna Maria de Luca had been proposed by me, she having kindly acted as our hostess, the company was invited to partake of the refreshments that had been most liberally provided.

It was now getting dusk, and those of the guests who expressed a desire to see the Hospital were conducted round in two parties, the first



by Dr Reynolds, and the other by myself. Some of the remainder sat down to take zakuska and refreshments, while the rest found they were compelled to leave on account of other engagements.

There was not the slightest hitch in the proceedings from beginning to end, and I think I am justified in stating that the inauguration of the Harbin Hospital was carried through in a highly successful manner.

S. P. CHEN, M.B., B.C. (Cantab.),

*Senior Medical Officer, Harbin Hospital.*

HARBIN, 30th August, 1913.

I feel it a great privilege to be able to offer my humble tribute of congratulation on the opening of the Isolation and Quarantine Hospital here in Harbin.

A few years ago when pneumonic plague raged in Manchuria and its welfare was threatened, the then Government of the Chinese Empire took measures to convoke an International Conference at Mukden, where delegates representing different Governments assembled and made researches, and studied the means of the prevention of the epidemic. Here again I am exceedingly glad to see the establishment of such institutions as this under the auspices of the present Government in different parts of Manchuria for the prevention of contagious diseases for the sake of humanity. Now Manchuria is a highway of the world, so to speak, and should any contagious disease become epidemic in the public road, thoroughfare would soon be stopped, and great would be the inconveniences suffered by different nations. We have little doubt but that the public health of Manchuria in future will be vouchsafed by this present institution undertaken by the authorities of the Government of China, and hereby I beg leave to express my profound thanks to the authorities concerned for the sake of humanity at general.

N. MURATA.





Harbin Hospital from the South. Winter, 1912.



Harbin Hospital. Quadrangle of Quarantine Block showing Officers' Quarters and part of the Out-patient Department. Summer, 1913.





## XX. SECOND REPORT OF THE HARBIN HOSPITAL.

APRIL 1ST—SEPT. 30TH, 1913.

BY DR S. P. CH'EN, B.A., M.B., B.C. (CANTAB.).

REPORT FOR QUARTER ENDING JUNE 30TH, 1913.

The drugs, medical appliances, etc., ordered from Europe soon after the establishment of the Service, began to arrive during this period, all the medicines supplied to patients previous to this having been purchased locally.

Numerous repairs and alterations were also commenced as soon as the weather became favourable.

(a) In the Quarantine Block most of the stoves which had been faultily constructed were pulled down and rebuilt according to approved Russian methods. The floors of the most important rooms were taken up and relaid after the necessary measures for rat-proofing them had been undertaken.

(b) The windows in the Suspects' and Plague Blocks which had been left uncompleted had all the missing panes put in.

The most important additions consist of the following:

I. *Construction.*

(a) Roads with a granite surface were laid down in all the compounds, and outside, thus rendering access to all the different parts of the hospital buildings possible, even after a heavy downfall of rain. Besides these, at a very small expense, a road was made leading from the termination of the town road to the hospital gates, the condition of the road in front of the hospital previous to this being such as to render it absolutely impassable on wet days.

(b) The quadrangle of the Quarantine Block was levelled and considerably improved.

(c) A large water house containing a powerful pump and a large iron tank was built at the south end of the quadrangle, so arranged that there would be a plentiful supply of good water all through the winter, the interior of the building being heated by means of a Russian stove.



## II. *Equipment.*

The common rooms for the use of the staff were furnished and the different wards in the portion to be utilised as a general hospital were made ready for the accommodation of in-patients.

The alterations to a portion of the northernmost of the three large pavilions in the Quarantine Block, so as to convert it into an operating room, were completed during June, and the necessary appliances were moved in soon after.

The two rooms set aside for the purposes of a laboratory were repaired during this period, and although some of the bacteriological apparatus had not arrived, it was possible to commence work in them. Dr Reynolds who came out from England early in May took over charge of the Laboratory on his arrival.

## III. *Planting.*

Owing to the bare condition of the neighbourhood it was found necessary to plant a large number of trees round the buildings. About 350 stumps (poplars) were planted around the compound; while a large number of young trees were planted in the different blocks. The former have done well up to the time of writing, but the latter have unfortunately all died, and have had to be uprooted.

## IV. *Attendance.*

The number of patients as noted in the report of the March quarter was then noticed to be steadily increasing. During the quarter under notice there has been a continued increase, the total attendance for the three months being 3767. The nature of the ailments encountered can be ascertained from the accompanying table. The Assistant Medical Officer has been visiting the prisoners in the Kirin Foreign Bureau regularly three afternoons a week, so as to give treatment to any that may need it.

## V. *Staff.*

In place of Dr Tang Tsung Nin, who has been transferred to Sansing, Dr Liu Yi Te is now Assistant Medical Officer.

The practice of employing student dispensers and dressers was commenced during this period, and so far the results have been encouraging. This is a matter of the greatest importance in view of the large demand there will be for such men when the other hospitals of the Service are ready to commence work.

The staff was increased during this quarter by the engagement of

Mrs Ts'ao, as Matron, and Mrs Yeh, a graduate of the Foochow Nurses' Training College, as Sister-in-charge.

On June 6th I handed over charge to Dr Reynolds, having had orders to proceed to Taheiho to make arrangements for the construction of Taheiho Hospital.

The report of Dr Reynolds for the period covering my absence from Harbin is appended.

REPORT ON PERIOD EXTENDING FROM  
JUNE 6TH TO JULY 17TH, 1913. (BY DR REYNOLDS.)

Owing to the large amount of uncompleted work in connection with various additions and alterations to the Hospital buildings on Dr Ch'en's departure to Taheiho, I was partially occupied in superintending the work of construction. When Dr Ch'en returned on July 17th, the necessary changes had almost entirely been completed.

*Staff.* Owing to a serious breach of discipline it was found necessary to dismiss the senior dresser, the circumstances attending which have already been reported in detail.

To cope with the large amount of work in connection with the cleaning of the compounds etc., I was compelled to engage extra coolies temporarily, and when this work was completed they were dispensed with.

*Alleged Cases of Infectious Disease.*

I. On July 1st an official communication was received from Taotai Li, the substance of which was as follows:

The Russian authorities had informed him that a case of small-pox had been reported from Ashiho, and that they were that day sending one of the Chinese Eastern Railway doctors to make investigations. They stated they had no particulars as to whether the case in question had occurred in the Railway area or in Chinese territory, and would therefore request the Taotai to send one of our officers to accompany their doctor. After consultation with Mr de Luca, it was decided to send Dr Liu, although it was extremely inconvenient just at this juncture. However, as it would have been a serious matter for us to have failed to comply with the request of the Russian authorities, Dr Liu had to go under any circumstances. He left at 8 p.m. the same day, travelling in a special car with the Railway doctor and an interpreter supplied by the Taotai. It was learnt that the case had been reported by the Russian military commandant of the Ashiho district.



Upon investigation it appeared that two cases of small-pox had been reported to the Harbin military authorities as having occurred in a small village called Yaoho. The doctors rode out to find the alleged cases, but after a search of some hours, not even the village could be found. They therefore decided to return to Harbin forthwith, both of them having agreed that the report must have been a false one.

II. On July 8th there was an article in the local Chinese newspaper mentioning the occurrence of infectious disease in Fuchiatien. It was agreed between Dr Liu and myself that we should make an offer to the local officials to investigate the matter. No sooner had this point been settled than a letter was received from the Titiao (in the Taotai's absence) stating that the Russian authorities had seen the article in the paper and were sending a doctor to Fuchiatien to make investigations. A reply was immediately sent drawing attention to the fact that as the reported cases were in Chinese territory, the Service doctors were quite willing and able to deal with the situation, and that if the Russian authorities were particularly desirous of sending one of their men to accompany our officers, we should be most pleased to allow him to do so, and would give him every facility. We suggested that if the Russian authorities decided to accept this invitation, their medical officer should first call at the Hospital where Dr Liu would wait for him. In the meantime enquiries were made with the result that the cases in question were found to be nothing more than dysenteric cases among prisoners suffering from the morphia habit.

During the afternoon there came to the Hospital two Russian doctors, a Chinese police officer and an interpreter,—the latter two having been sent from the *Yamen*.

Dr Liu forthwith explained to the visitors that:

(a) Our staff and accommodation were quite efficient for coping with any outbreak of infectious disease, and that we were quite prepared to deal with cases of epidemic disease occurring in Fuchiatien and its neighbourhood.

(b) Negotiations were being carried on with the Prefect to have all suspected cases reported to us for investigation by our medical staff, and

(c) Arrangements were being made for handing over the control of sanitary affairs to our Service.

Both the Russian doctors expressed themselves completely satisfied with our arrangements and would take our statements with regard

to the alleged cases. They thereupon wrote out a telegram which they stated they would at once dispatch to St Petersburg to inform the authorities there that there was no cause for alarm, and at the same time would communicate what they had learned about our Service.

We impressed upon them our readiness to co-operate with them on all occasions, and they left with an expression of gratitude for the courtesy shown to them.

III. On July 9th there was an article in a local Chinese paper stating that a report had been received from Hulan to the effect that there was an outbreak of cholera there. We immediately inquired of the magistrate by wire if there was any foundation for the rumour and received an answer in the negative.

(Sgd.) S. P. CHEN, M.B.,

*Senior Medical Officer.*

#### REPORT FOR QUARTER ENDING SEPTEMBER 30TH, 1913.

Before my departure for Taheiho it had been arranged to have the Hospital formally opened on July 12th. For this reason the commencement of the quarter under review was partly taken up with the completion of the necessary preparations for the inauguration. Owing, however, to unforeseen circumstances in connection with the Taheiho Hospital construction my return to Harbin had to be delayed until July 17th. For this and other reasons the date of the formal opening was postponed until the last week in August.

*Attendance.* The number of patients treated and the ailments they suffered from are stated in the Summary of patients treated.

The public was duly notified that from August 28th—the first day after the inauguration of the Hospital—in-patients would be received provided that they conformed to our regulations.

The large Thresh Disinfector arrived here on August 27th. Steps were immediately taken to have it permanently erected in the back portion of the Quarantine Block. Communication with the two other blocks is obtained by means of a large door in the wall of the Quarantine Block that faces the other blocks: so that eventually all infected material will have access to the disinfector without having to pass through the front portion of the Quarantine Block at all.

Arrangements have also been made for the supply of electric light to the Hospital.



One of the most important points to be recorded for the September quarter is the progress made towards gradually obtaining control of the sanitary affairs of Fuchiatien. A report of the number of deaths occurring in Fuchiatien is sent to the Hospital regularly, and the police have requested our assistance to prevent further dumping of waste material and dirty water in the public streets, and with reference to the prohibition of the sale of unwholesome food.

Negotiations have been in progress for the transfer to the Service of at least a part of the power hitherto vested in the Tzu Chih Hui (Municipal body), and other lay bodies. There is every indication that the lay officials are willing to work in co-operation with our officers in sanitary matters.

(Sgd.) S. P. CHEN, M.B.,

Senior Medical Officer.

Summary of patients treated (Harbin Hospital).

		Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
I.	Specific infectious diseases—	—	—	—	—	—	—	—	—	—	—
	(a) Bacterial diseases—	—	—	—	—	—	—	—	—	—	—
	1. Typhoid fever ...	—	—	—	—	1	—	—	—	—	—
	2. Erysipelas ...	—	—	—	—	—	—	—	—	—	—
	3. Diphtheria ...	—	—	—	—	—	—	—	—	—	—
	4. Pneumonia ...	—	—	—	—	—	—	—	—	—	—
	5. Influenza ...	—	—	—	—	—	—	—	—	—	—
	6. Whooping cough...	—	—	—	—	—	—	—	—	—	—
	7. Gonococcus infec-										
	tions ...	6	1	8	11	7	8	5	7	16	16
	8. Dysentery ...	—	4	1	—	1	11	17	8	16	19
	9. Cholera ...	—	—	—	—	—	—	—	—	—	—
	10. Plague ...	—	—	—	—	—	—	—	—	—	—
	11. Tetanus...	—	—	—	—	—	—	—	—	—	—
	12. Leprosy ...	—	—	—	—	—	—	—	—	—	—
	13. Tuberculosis ...	—	30	27	19	31	57	35	20	26	38
	(b) Non-bacterial fungus in-										
	fections ...	—	—	—	4	—	1	3	1	—	—
	(c) Protozoan infections—										
	1. Malaria ...	—	—	—	—	—	4	4	11	12	8
	2. Relapsing fever ...	—	—	—	—	—	—	—	—	—	—
	3. Syphilis ...	14	20	30	78	43	38	38	76	61	64
	(d) Metazoan diseases—										
	1. Intestinal cestodes,										
	tapeworms ...	—	—	—	—	—	—	—	—	—	—
	2. Diseases caused by										
	nematodes ...	1	2	5	5	1	23	25	20	31	23
	3. Parasitic insects ...	—	1	—	15	1	—	14	9	6	8

Dec. Jan. Feb. Mar. April May June July Aug. Sept.

(c) Infectious diseases of unknown etiology—

1.	Small-pox	...	—	—	—	—	—	—	—	—	—	—
2.	Chicken-pox	...	—	—	—	—	—	—	—	—	—	—
3.	Measles ...	...	—	—	—	—	—	—	—	—	—	—
4.	Scarlet fever	...	—	—	—	—	—	—	—	—	—	—
5.	Epidemic parotitis (Mumps)	...	—	—	—	—	—	1	2	4	1	1
6.	Typhus ...	...	—	—	—	—	—	—	—	—	—	—
7.	Yellow fever	...	—	—	—	—	—	—	—	—	—	—
8.	Rheumatic fever	...	—	13	9	26	19	9	11	6	7	15
9.	Acute tonsilitis	...	2	2	5	1	4	1	1	2	1	2
10.	Acute catarrhal fever ...	...	—	5	4	4	6	2	1	—	—	2

II. Intoxications—

(a) Alcoholism	...	—	—	—	1	—	—	—	—	—	—
(b) Morphia habit	...	—	—	—	—	1	4	—	1	—	2
(c) Lead poisoning	...	—	—	—	—	—	—	—	—	—	—
(d) Arsenical poisoning	...	—	—	—	—	—	—	—	—	—	—
(e) Food poisoning	...	—	—	—	—	—	—	—	—	—	—
(f) Beri-beri	...	—	—	—	—	—	—	—	—	—	—

III. Diseases of metabolism—

(a) Gout	...	—	—	—	—	—	—	—	—	—	—
(b) Diabetes	...	—	—	—	—	—	—	—	—	—	—
(c) Rickets	...	—	—	—	—	—	—	—	—	—	—
(d) Scurvy	...	—	—	—	—	—	—	—	—	—	—

IV. Diseases of the digestive system	...	12	31	23	88	94	192	126	153	132	89
V. „ „ respiratory system	...	13	89	61	120	98	93	51	66	51	25
VI. „ „ genito-urinary system	...	—	7	18	15	13	16	10	16	20	15
VII. „ „ blood	...	—	11	5	8	12	36	22	17	19	21
VIII. „ „ circulatory system	...	4	26	23	66	46	20	15	21	11	18
IX. „ „ ductless glands	...	—	5	4	1	—	9	4	—	4	1
X. „ „ nervous system	...	6	36	22	26	25	28	4	13	11	16
XI. „ „ locomotor system	...	8	12	2	2	20	76	73	66	74	31
XII. „ „ eye	...	11	20	34	99	62	125	112	90	82	76
XIII. „ „ skin	...	4	14	17	30	42	23	16	16	13	23
XIV. „ „ nose, throat & ear	...	10	20	14	25	6	19	6	2	5	5
XV. Diseases of women	...	—	11	10	11	9	12	—	2	—	1
XVI. Surgical cases	...	19	88	87	269	467	743	586	604	811	595
XVII. Vaccination	...	—	—	—	4	3	24	1	—	—	—
Minor operations	...	1	4	5	21	8	51	43	44	69	58

Total (not including minor operations) 112 449 410 932 1012 1574 1181 1229 1413 1114



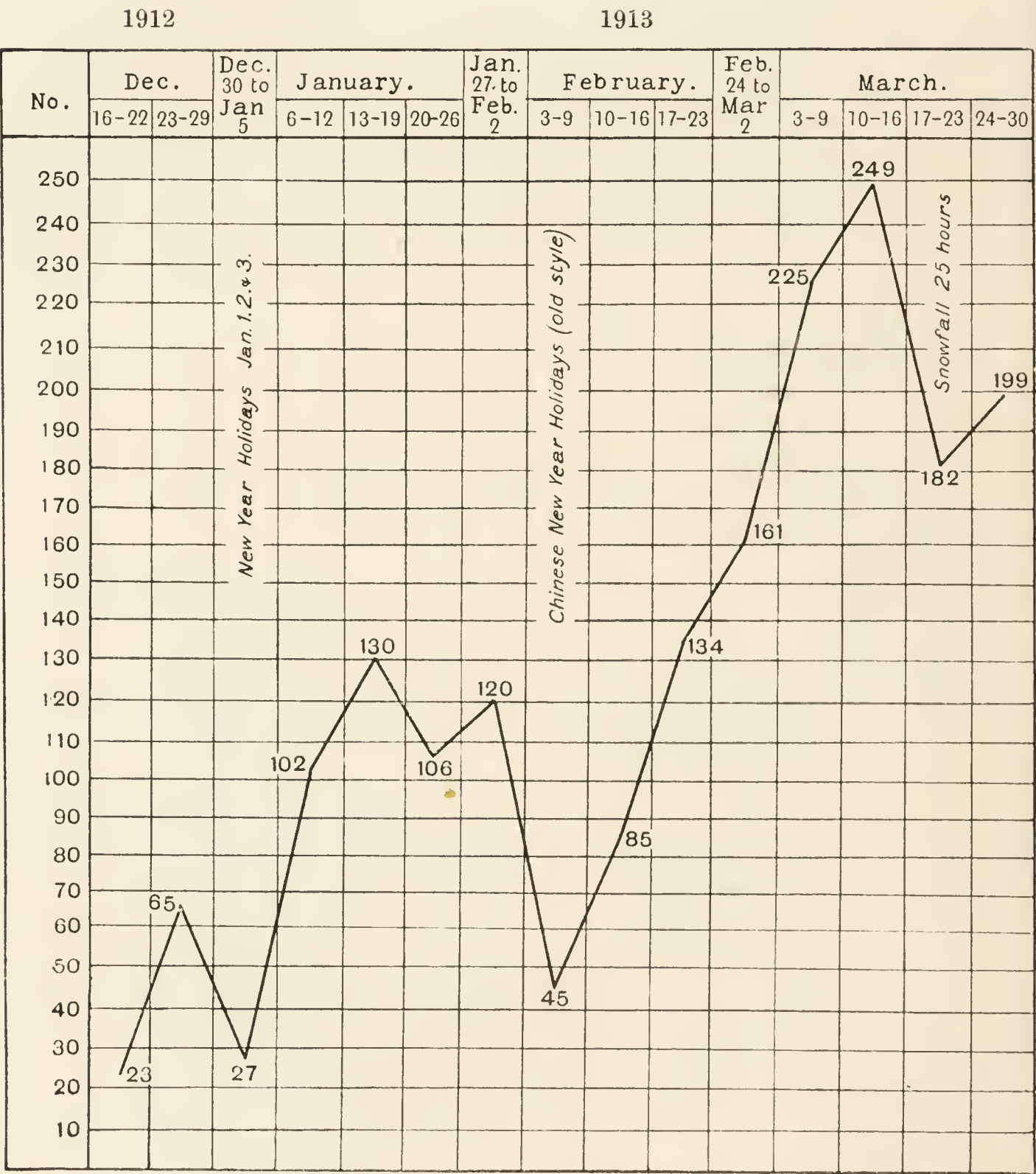


Chart of Weekly Attendance at the Harbin Hospital.

## XXI. REPORT ON TOUR OF INVESTIGATION TO SANSING, LAHASUSU, AND TAHEIHO.

BY DR S. P. CH'EN, B.A., M.B., B.C. (CANTAB.).

### *The Journey to Taheiho.*

I left Harbin by the s.s. *Equator* at 6.30 p.m. on Friday, June 6th. Although the water in the River Sungari was very low, we reached Sansing without any mishap at 7.30 p.m. the next day.

The steamer left Sansing the same evening at 9.30 p.m., arriving at Lahasusu at 2.30 p.m. on Monday, June 9th. Dr E. Hwang (Medical Officer at Lahasusu) met me, and although I went over to the Hospital, I did not then make a minute investigation on account of the uncertainty as to the length of time the boat intended to remain in port.

The steamer remained longer than expected, and eventually had all the passengers and cargo from the s.s. *Vostok* and her barge transferred on to her. The vessel, after leaving Lahasusu, travelled at a much slower pace, owing not only to the stream, but also to the increased amount of freight. On Saturday, June 14th, the fifth day from Lahasusu, she ran into some shallows, and was obliged to remain there for several hours. We arrived at Blagoveschensk, the Russian city opposite Taheiho, on June 15th, and in crossing the river to the latter town, the vessel struck a rock and sprang a leak. This delayed us for fully six hours, after which we were transhipped to the s.s. *Siber* which ultimately landed us on the south bank of the Amur, about three miles below Taheiho.

### *At Taheiho.*

On June 16th I went with Dr C. H. Luk (Asst. Medical Officer at Taheiho) to see the Kuan Ch'a Shih, Mr Chang Shou Tseng. I was informed that a plot of land had been reserved for the site of the proposed Hospital, and, on leaving the *Yamen*, we proceeded with the



Acting Aigun *hsien*, Mr Huei, to examine the spot chosen. The site reserved is on the south-eastern side of the town, at the junction of the 7th street (running from East to West) and the Hsiao Tung Road (running from North to South). It is situated on a level not lower than the business quarter of the town, and is about half a mile distant from the *Yamen* and Customs Office. It consists of 4 Lots (Nos. 483, 484, 553, and 554), and measures 200 feet from East to West, and 300 feet from North to South. Of this area a small portion will be set aside for the purpose of the proposed roads.

At the present time there are no residential or shop buildings near by, although a large theatre is being built a little distance from the selected site. According to information received, that part of the town will, in the course of time, be of great importance, as it has been arranged to erect the proposed Post Office and other official buildings in that quarter. The fact that a large theatre—larger than the existing one in the middle of the town—is springing up there shows that it is more than probable that that portion of the town will, in the near future, be converted into a busy quarter.

While at the Kuan Ch'a Shih *Yamen* I made inquiries about the old Hospital that was built during the plague epidemic of 1910–1911<sup>1</sup>, as I thought the site and buildings should be the property of the Service. The officials said they were not certain on the point, it being generally understood that the Hospital had been built out of local funds and not from the Three Eastern Provinces Plague Fund. However, I sent the Kuan Ch'a Shih an official dispatch on the subject the next day, and obtained a reply from him promising to have the matter fully investigated. Up to the time of writing no official reply had been received.

The old Hospital consists of three small wooden buildings in a small compound surrounded by wooden palings. It is at present the official residence of the Heilungchiang Inspector of Gold mines (Chin K'wang Tu Ch'a *Yamen*), and I was informed by Mr Lin, the present Inspector, that he had spent a considerable amount of money on repairs to render the buildings habitable.

I visited Mr Chang Shou Tseng again the next day and discussed the subject of the new Hospital with him. He offered to find an architect for the purpose, and I was eventually brought into contact with Mr Brusinsky, with whom I entered into an agreement to draw

<sup>1</sup> This hospital was erected although no cases of plague occurred in the district in 1910–1911.

the necessary plans for the Taheiho Hospital and to supervise the construction. The total fee was agreed at Rs. 375, part of which (Rs. 150) was to be paid on delivery of the plans, and the remainder (Rs. 225) on the satisfactory completion of the buildings.

The next fortnight was spent in arranging details for the buildings and for the agreement that was to be signed with the successful contractor.

The plans for the Doctor's residence were completed on Wednesday, June 25th, and those for the Quarantine building and servants, quarters three days later, June 28th. With the plans ready I lost no time in inviting tenders for the construction. The only means of publication was by fixing notices up at different points, calling for tenders and allowing a period of 7 days only, as I was pressed for time on account of the proposed opening of the Harbin Hospital on July 12th.

The tenders were very slow in coming in: on this account I felt obliged to send the following telegram to Mr de Luca (Commissioner of Customs and Lay Director): "Fear difficulty finding contractor may prevent returning in time opening Harbin Hospital. Is postponement advisable?" and I received a reply to the effect that the opening had been postponed pending my return.

The following were the tenders received:

1.	Liu, owner of large bath-house, for	Rs. 19,000	} Exclusive of ice-house and lavatory.
2.	Yü Ssu Yü, contractor ... ..	15,600	
3.	Liu Tsung Li, of the Commercial Guild ... ..	15,500	
4.	Lu, Shanghai carpenter ... ..	14,743	Including ice- house and lavatory.

The last tender was accepted, but, on discussing the matter of providing surety, I learnt that the contractor was not only unable to find suitable security, but was also not able to carry on the work without obtaining a substantial advance. That being the case, I felt compelled to offer the work to the next lowest tender. Before negotiations could be entered into with the next contractor, Liu Chiao Hsi, Manager of the Taheiho Electric Light Company, undertook to do the work for the same amount as that mentioned in the lowest tender. As he was able to provide suitable security, and, at the same time, did not require any advance, provided the Kuan Ch'a Ssu would act as my surety, I



decided to have the Hospital built by him. This was on the morning of Thursday, July 3rd, and the same afternoon I went to see the Kuan Ch'a Shih to request him to act as my surety. He agreed to do so, and it was decided that the contract between Liu Chiao Hsi and myself, acting on behalf of the Service, should be signed in the *Yamen* at 10 a.m. the next morning (July 4th).

We met at the *Yamen* at the appointed time, but the Kuan Ch'a Shih informed me, that he, being a Government official, was, under the new regulations, not allowed to act as surety for anybody. Thereupon the contractor said he could not agree to sign the contract unless the Service was prepared to make him the large advance of Rs. 10,000 for the purchase of building material.

With myself secured either by the Kuan Ch'a Shih, or, as I learnt later, by the Aigun Customs, the contractor would be able to carry on the work without advances of any kind. Thereupon I promptly wired to the Commissioner in Harbin as follows: "No contractor here will undertake work without large advance unless local Customs act as my security. Can you wire required authority immediately, failing this necessary find contractor elsewhere?" This was sent on July 4th at 7.30 p.m.

On Sunday, July 6th, the Commissioner replied thus: "Aigun Customs authorised act as security for Dr Chen but cannot supervise building of hospital nor be responsible for execution of contract. Contractor also should be solidly secured."

I went to see the contractor without delay, and arranged that the contract should be signed at the Customs office at 4 p.m. the same afternoon. After having gone through the contract for the last time, our signatures were affixed at 5 p.m. on July 6th.

The original contract I left in charge of Dr Luk for registration in the *Yamen* and for reference in the event of a dispute arising in the course of construction. Appended is the full English translation.

I was now ready to leave Taheiho for Lahasusu. Before my departure I gave Dr Luk full instructions with regard to the supervision of the buildings, and I also wired to the Commissioner to remit a sum of Roubles 4500 to be kept in readiness at the Aigun Customs for the payment of the first instalment according to the agreement.

I left Taheiho at midnight on Monday, July 7th, by the first boat available, the s.s. *Hercules*.

*Lahasusu.*

I reached Lahasusu on Thursday, July 10th, at 4 a.m.

The roads to the Hospital were in a terrible state owing to the recent heavy rains.

The exterior of the Hospital buildings appeared to be in a sound condition, but on inspection of the interior of the various blocks I suggested various alterations.

I requested Dr E. Hwang to ascertain the approximate cost for the necessary alterations, and to send in a demand for the sum required as soon as possible.

The first passenger steamer bound for Harbin was the s.s. *Port Arthur* which arrived at Lahasusu at 10.30 p.m. on Saturday, July 12th. I left by her just before midnight on the same date.

It is interesting to note that during my stay at Lahasusu I saw only one mosquito although swamps abounded in this district.

*Sansing.*

I arrived at Sansing on Monday, July 14th, at 5.30 p.m., and was met by Dr Tang. As soon as I got ashore I went into the city with Dr Tang to inspect the site and buildings for use as Sansing Hospital, in order to obtain an idea of the kind of repairs that are needed.

Having done this I prepared to leave Sansing by the next boat bound for Harbin.

The next day, Tuesday, July 15th, I left Sansing by the s.s. *General Kondratenko* at 5 p.m., arriving at Harbin on Thursday morning, July 17th. I did not think it wise to stop on the way to make inquiries about the purchase of firewood for use at the Harbin Hospital in the coming winter, considering that my stay in Taheiho had been unavoidably rendered longer than I expected, and that my presence in Harbin might be required for the completion of all the necessary preparations for the opening of the Hospital.

(Sgd.) S. P. CHEN,

*Senior Medical Officer.*

HARBIN, *July 24th*, 1913.



## SUPPLEMENTS

*(a) Veterinary Surgeon.*

Just before my departure from Taheiho, Mr Chang Shou Tseng discussed the matter of our Service taking up the work of examining all the cattle destined for the Russian side, and any other veterinary work that might require our attention from time to time. He said that the Russian authorities had communicated with him on the subject of the veterinary inspection of all cattle going across the Amur, and had suggested that they should send one of their own veterinary surgeons and his staff over to Taheiho to do the work. Mr Chang asked me if the Service could undertake the examination referred to, and as we had no veterinary surgeons in the Service, and as no funds had been set aside for such purpose, I told him that all I could do in the matter would be to include the subject in my report, and see what steps could be taken to help him out of his difficulties. I suggested that in the meantime he might employ a Russian veterinary surgeon to be stationed at Taheiho as a servant of the Chinese government, as I felt sure it would have the support of the Russians, seeing that all the cattle concerned were for Russian consumption.

At the time in question, there was not the slightest indication of the presence of disease among cattle brought into Taheiho.

Mr Chang also inquired if the Service could supply a medical officer to accompany some Russian veterinary surgeons who had asked him for permission to travel inland to investigate into certain diseases alleged to be present among cattle. As we had no officers available for that purpose, Dr Luk's presence in Taheiho being required for the supervision of the new Hospital buildings, I had to answer him in the negative.

During the conversation, however, I assured him that the matter of engaging a veterinary surgeon by the Service had already been carefully considered by the Chief Medical Officer; and that, in the latter's first report to the Wai Chiao Pu the question had been brought up, and the appointment of a veterinary surgeon strongly recommended.

*(b) Agreement between LIU CHIAO HSI, Manager of the Taheiho Electric Light Company, hereinafter called the contractor, of the one part, and Dr S. P. Chen, Senior Medical Officer, Harbin, acting*

on behalf of the North Manchurian Plague Prevention Service, of the other part.

It is hereby agreed that

I. The contractor should construct for the North Manchurian Plague Prevention Service the undermentioned buildings :

1. A two-storeyed Doctor's residence.
2. A Quarantine ward.
3. An Outhouse or Servants' quarters.
4. An Ice-house.
5. A Water-closet.

Plans are supplied of the first three only ; and specifications for all are given in detail below.

II. The price is to be Roubles 14,743 + Rs. 120 (= Rs. 14,863.00), the extra sum being for additional half arsheen to upper floor of Doctor's residence, thus making the lower floor 5 arsheens, and the upper floor  $4\frac{1}{2}$  arsheens.

### III. *Specifications :*

A. All measurements on plans are Russian ; when English measures are used they are specially stated.

B. Bricks must be darkish red in colour, of the best quality, and 6 verschoks  $\times$  3 verschoks  $\times$   $1\frac{1}{2}$  verschoks in size.

C. Wood must be best dry wood obtainable : special measurements will be given under the different headings.

D. *Foundations :* Depth from level of ground surface must be  $2\frac{3}{4}$  arsheens. The earth has to be beaten down, and then stone of the best quality used to form concrete. Width of foundation, 2 arsheens.

E. *Walls :* From the level of the surface of the ground there must be a layer of granite  $\frac{1}{4}$  arsheen in thickness, before the brickwork commences. Walls coloured *red* on plans are of brick, while those coloured yellow are described below.

1. Doctor's residence walls :

Ground floor (a) Outer walls— $2\frac{1}{2}$  bricks on end—15 verschoks.

(b) Inner walls—2 „ „ „ 12 „

Upper floor (a) Outer walls—2 „ „ „ 12 „

(b) Inner walls— $1\frac{1}{2}$  „ „ „ 9 „

Walls between rooms, coloured yellow on plan, are to be constructed in the way described below, and are to be  $3\frac{3}{4}$  verschoks in thickness.

In middle—beam  $2\frac{1}{2}$  verschoks thick. Planks on either side, to which are fixed laths ; then comes the plaster.



Ground floor walls are to be painted white on inner surface.

Upper floor „ „ „ „ whitewashed „ „ „

Walls of all rooms must have rounded corners.

2. Quarantine ward walls :

Outer walls—2 bricks on end—12 verschoks thick.

Inner „ 1 brick 6 „ „

3. Outhouse (Servants' quarters) :

Outer walls— $1\frac{1}{2}$  bricks on end—9 verschoks thick.

Inner „ 1 brick 6 „ „

F. *Floors*: The earth must be beaten down with a mixture of sand and lime for a depth of one English foot; over this should be spread 4 inches of dry sand, filling in the space between the floor beams and reaching almost to the under surface of the floor boards.

The floor boards are not to be nailed down to the floor beams. All cracks in the floors have to be remedied in the spring of 1914.

1. Doctor's residence floors : Beams to be used should be :

18 of 11 arsheens in length, thickness 6 vers.  $\times$  5 verschoks.

18 of  $7\frac{1}{2}$  „ „ „ „ 6 „ 5 „

The long and short beams must alternate.

Floor planks should be  $1\frac{1}{4}$  verschoks thick, 5 verschoks wide, and 9 arsheens long.

2. Quarantine ward floors :

Beams: 10 pieces, 9 arsheens long, 5 vers.  $\times$  3 verschoks thick.

10 „ 6 „ „ 5 „  $\times$  3 „ „

Planks:  $1\frac{1}{4}$  verschoks thick, 5 vers. wide; half of 12 arsheens, other half of 9 arsheens in length.

3. Outhouse floor. Concrete.

G. *Ceilings* :

1. Doctor's residence :

Beams used are to be 5 vers.  $\times$  4 verschoks thick.

Planks, 1 verschok thick by 5 verschoks wide, and 9 arsheens long. There are to be two layers of plank, one on either side of the beams. The lower layer of plank is to be plastered on the under surface and then whitewashed. Above the upper layer of plank should be a layer,  $\frac{1}{2}$  verschok in thickness, of a mixture of lime, sand, and water, while over this again is spread a layer of dry earth, 1 verschok in thickness.

2. Quarantine ward :

Beams used are to be 4 vers. by 3 verschoks in thickness.

Planks as in Doctor's residence.

H. *Roofs*: For all the buildings these are to be of thick sheet-iron-roofing, painted a darkish-red colour, similar to the roofs over in Blagovestchensk. There must be 3 coats of paint.

1. Doctor's residence: Roof beams should be

$4 \times 3$  verschoks thick.

$4 \times 2\frac{1}{2}$  „ „

2 and 3. Quarantine ward and Outhouse: Roof beams should be

$4 \times 3$  verschoks.

$2\frac{1}{2} \times 1\frac{1}{2}$  „

$3 \times 2$  „

$3 \times \frac{3}{4}$  „

I. *Stoves* must be of the approved Russian pattern. All stoves are to be brick with the exception of those drawn round in plans. These latter should be brick covered over with iron.

J. *Doors*: All doors opening to exterior of buildings must be double, and painted dark brown (pig's liver colour).

Inside doors are to be painted white.

K. *Windows*: All double and painted white. All glass panes must be put in, and be in good condition before handing over to the representative of the Service.

The brickwork projection round windows is to be  $1\frac{1}{2}$  verschoks or quarter of a brick.

L. *Painting*: All painting must be done three times over.

M. Door and window handles must be of good, strong quality, and made of brass. If procurable, nickel-plated bolts are to be used; if not, strong brass ones will suffice.

All locks and keys must be of a superior quality.

N. *Drain-pipes*: Suitable drain-pipes, made of strong material and firmly fixed, should be put in, leading to drains dug out round buildings. From the bath-room of the Doctor's residence a drain is to be put in according to the instructions of the doctor in charge.

O. *Kitchens*:

1. Doctor's residence: Stove of approved foreign style with oven, and cover for smoke.

2. Servants' quarters: Chinese cooking stove.

P. Outhouse (Servants' quarters): The middle of the three rooms is to be supplied with a K'ang.



Q. Balcony of Doctor's residence: The beams should be covered over with planks  $1\frac{1}{4}$  verschoks in thickness. Over this should be a layer of concrete 6 English inches thick, and over this again a layer of cement 1 English inch thick.

R. All *Doorsteps* are to be of granite.

S. A flagstaff is to be erected, and access to the roof obtainable by means of a trap-door and stairs in the bath-room.

Access to the roof of the Quarantine ward should also be allowed by means of a trap-door.

T. Ventilators must be supplied to all the rooms.

U. A Water-closet for servants and patients is to be constructed of logs with felt intervening. There should be three compartments as in diagram. The floor is to be of cement.

V. An Ice-house, size 1 sarjhen by 1 sarjhen, is to be constructed with brick floor, and wooden sides. Roof to be of plank, supplemented by a thick layer of earth externally.

IV. The contractor must thoroughly clear the compound before handing over to the Service.

V. The contractor undertakes to repair all cracks in stoves or walls for a period of 12 months from the date of handing over.

VI. The contractor guarantees the buildings for a period of 5 years.

VII. *Conditions of Payment:*

The 1st instalment of Rs. 4,500.00 will be paid upon the completion of the foundations, provided that there is, at the time, in the opinion of the doctor in charge, material to the value of Rs. 2,500.00 on the Hospital premises.

The 2nd instalment of Rs. 1,500.00 will be paid on the completion of the walls of the buildings to the top of the first floor, provided that there is, at the time, unused material to the value of that amount (Rs. 1,500) on the premises.

The 3rd instalment of Rs. 1,000.00 will be paid on the completion of the walls up to the roof, provided that there is unused material on the premises worth that amount at the time.

The 4th instalment of Rs. 3,000.00 to be paid on the completion of woodwork.

The 5th instalment of Rs. 2,500.00 on completion of painting, and the 6th instalment of Rs. 2,063.00 on handing over to the Service.

A sum of Roubles 300 is to be retained for the purpose of repairs to

floor and other portions of the buildings that may be required in the spring of 1914.

VIII. All work must be discontinued on and after September 20th, 1913, and resumed at the earliest possible date next year, to be determined by the Service. The buildings, however, must be handed over to the Service before June 15th, 1914, after which date there will be a penalty of Roubles 5 per day.

IX. All payments will be made only upon the satisfactory completion of the different stages according to the terms of the contract, as certified by the medical officer in charge. Mr Brusinsky will only act as adviser to the medical officer.

X. Should unforeseen circumstances arise which necessitate the discontinuation of the work, it is agreed that the Service should pay for the parts already completed, and for material already conveyed to the Hospital grounds.

XI. The contractor undertakes to give written notice to the medical officer in charge locally, at least one week before the completion of each stage to ensure prompt payment. In the event of the Service failing to make the required payment in due time, the guarantor of the Service (the Aigun Customs) will be responsible for payment on behalf of the Service.



## XXII. DESCRIPTION OF TAHEIHO.

BY DR S. P. CH'EN, B.A., M.B., B.C. (CANTAB.).

(With Plate XXIII.)

*The Town.*

The town of Taheiho is situated in Heilungchiang Province on the south bank of the river Amur, directly opposite the Russian town of Blagoveschensk, the distance from Harbin by water being approximately 915 miles. It is known by various other names such as "Helampo" (used by the Telegraph Administration, and derived from Hai Lan P'ao, a large pond situated behind the Taotai *Yamen*), and Saghalian, as it is called by the Russians.

The town itself is situated on high ground, and stretches for a distance of about one mile along the river bank, and about a quarter of a mile inland.

It has been planned more satisfactorily than most Chinese towns in Manchuria, with the exception of Mukden. There are no metalled roads, although attempts have been made to render some of them passable in wet weather by using a surface of sand and shingle taken from the river bank.

On the whole the town may be said to be clean: there is certainly a great difference between it and some of the other towns in North Manchuria that I have visited, *e.g.* Fuchiatien, Hulanfu, Shuangchengpu, etc. The absence of malodorous lanes, and filth in the streets cannot fail to be noticed. Judging from what I heard while at Taheiho a serious attempt is being made to exercise a closer control over sanitary matters than is usually the case. The houses have been built in a more substantial manner than those one sees in most Chinese towns of that size. There are some low and unattractive looking buildings, but the existing signs point to the probability of these being destroyed and replaced by houses of more modern construction.

At the time of my visit, numerous signs of the devastation caused by the two last fires were still in evidence, and it was also obvious that energetic efforts were being made to reconstruct the buildings so destroyed, so much so that the supply of bricks from the several large kilns in the neighbourhood was quite insufficient to meet the demand. New buildings of modern type are springing up in all directions and form a strong contrast to the low one-storeyed buildings of former times.

### *Population.*

Taheiho has a floating population of between 15,000 to 30,000 Chinese, and some Japanese and Russians. The last mentioned consist chiefly of cattle dealers, small store-keepers, and restaurateurs, while the Japanese community comprise two doctors, two dentists, small tradesmen, barbers, and women of ill-repute. The Russian interests are looked after by a Consul, while those of the Japanese residents are, as far as I can ascertain, in the hands of the leading Japanese medical practitioner.

The Chinese population may be divided into two main classes: those that are resident, and those who use the town as a stage in their journey towards their destination farther up the river Amur.

Of the resident population there are quite a number of well-to-do merchants. There are also numerous shops which have an undoubted appearance of prosperity about them. On inquiry I ascertained that the Chinese mercantile community was gradually but surely obtaining total control of all the business of the town. A great deal of money is being made by the Chinese cattle-dealers who procure from Mongolia the cattle for the supply of meat required by the Russian community in Blagoveschensk.

The other class of inhabitants consists exclusively of coolies from Chili and Shantung on their way to try their fortune in the Government gold mines farther up the river Amur. These mines support between them a population of between 40,000 and 50,000: of this total a large number return annually to their homes after having earned considerable sums. Every spring, soon after the rivers Sungari and Amur are open to navigation,—usually not by the first few vessels on account of the increased cost of travel by them,—thousands of coolies go up to the gold mines abovementioned, breaking their journey for a few days at Taheiho; and every autumn, before the closing of the river, as many



thousands return to their homes. There are some features in connection with Taheiho which will immediately attract the attention of any stranger:

1. The enormous number of gambling houses in proportion to the population. No matter what time of day one passes by these establishments there is always a large number of men gathered round the tables.

2. There appear to be an unnecessarily large number of houses of ill-repute in a town of its size. The inmates of these houses consist of Chinese and Japanese.

3. The number of Chinese eating-houses and places of amusement also seems to be out of proportion, to the resident population at any rate.

From these facts it is evident that every attempt is made to deprive the returning miners of some of their savings before they can leave Taheiho. It seems to be a fact that most of those miners who are unfortunate enough as to miss the last Harbin-bound steamer in the autumn and are thus compelled to remain behind until the next spring, part with considerable portions of their earnings before the river re-opens.

#### *Climate.*

The climate is excellent,—dry, like the rest of Manchuria. From reliable records the highest summer temperature last year was 97° Fahr., and the lowest winter temperature —44° Fahr. Frost usually commences about the middle of September: last year it was noticed first on September 12th.

The health of the town, as far as can be ascertained, is very satisfactory.

#### *Mercantile notes.*

The large business houses, with the exception of those that deal in cattle and timber, consist chiefly of dealers in stores imported from the south. The prices of everything considerably exceed those prevailing in Harbin, even allowing the additional cost of freight. There is also a huge traffic in spirits, chiefly of cheap qualities of vodka, intended eventually for the Russian town opposite: and from what I have heard, the heavy duties on such imports into Russian territory are usually evaded by means of smuggling.



View of Tabeiho Town along the Bank of the River Amur.





*Cost of living, etc.*

The prices of the necessities of life are exceedingly high: often it is even impossible to procure meat and vegetables. Although cattle is seen to be plentiful, yet these are all destined for the Russian market in Blagoveschensk, and those who can afford it are compelled to go thither for their beef.

Chickens are imported from towns on the Sungari such as Tamali etc. With reference to this subject it is worthy of note that vegetables and other farm produce are not very plentiful in Taheiho in spite of the fact that they are grown in its neighbourhood. The reason is that the farmers find a more lucrative market for their goods over on the Russian side, although the restrictions concerning only Chinese visitors to Blagoveschensk are such as not only to cause considerable annoyance but also involve an expense of 99 kopecks for every journey across.

*Communications.*

In the winter Taheiho is practically cut off from the rest of China. The only means of communication is by road to Tsitsikar, the journey occupying 10-12 days. While at Taheiho I was informed by the present Taotai, Mr Chang Shou Tseng, that he was making arrangements for running during the coming winter a regular motor passenger and mail service to Tsitsikar,—there are no postal arrangements between Taheiho and other Chinese towns except by way of Russia. It is unnecessary to add that this plan is not feasible during the summer months as there are at present no good roads.

*Fires in Taheiho.*

There have been several fires of considerable magnitude during the last few years, the latest occurring early this year, involving a loss of over a million roubles, and very nearly razing the whole of the business quarter to the ground. However, although the houses are built as fast as they were burnt down, the Taotai and the responsible officials have decided on taking precautionary measures against further conflagrations. No wooden houses are in future permitted to be built within the town radius, and I was given to understand that a steam fire-engine had already been purchased and was on its way out from Europe.



*Medical notes.*

The town and its neighbourhood were not affected during the outbreak of Pneumonic Plague in the winter of 1910-1911.

From inquiries made there has not been any epidemic disease.

During my stay there, in the summer, although there were enormous numbers of flies everywhere, not many cases of diarrhoea and dysentery were brought to my notice. This is no doubt due to the fact that the town is reasonably clean, and unwholesome food and fruit were not hawked about because of their high price.

The water-supply is plentiful and good: although the water is hard. While in Taheiho I heard rumours to the effect that rinderpest was prevalent about the neighbourhood. Upon making inquiries I learnt that there was certainly no disease among the cattle imported into Taheiho.

The hot weather having only commenced during my visit, no mosquitoes were available for examination.

*Miscellaneous.*

Within a distance of about 100 li from Taheiho I was informed that a tribe similar to the "Fishskin Tartars" of Lahasusu could be found. Their local name is Woa Lung Ch'un. They, like the Lahasusu tribe, are of Tartar origin, and live by fur-hunting. They are practically never seen except during the winter when they enter the town for the purpose of selling their furs. As they live such a distance off, not much seems to be known about their habits.

(Sgd.) S. P. CHEN.

20th September, 1913.

## XXIII. TABLE OF DISTANCES FROM HARBIN.

I. By the Chinese Eastern Railway:—					
	To Manchoulie	...	...	...	584 miles.
	Tsitsikar	...	...	...	169 „
	Changchun	...	...	...	152 „
	Nikolsk-Ussuri	...	...	...	418 „
	Vladivostok	...	...	...	486 „
II. By the South Manchurian Railway:—					
	To Mukden	...	...	...	341 „
	Dairen	...	...	...	588 „
III. By the North China Railways:—					
	To Peking	...	...	...	865 „
IV. By the Chosen Railway:—					
	To Antung	...	...	...	511 „
	Fusan	...	...	...	1096 „
V. By River:—					
	To Sansing	...	...	...	216 „
	Lahasusu	...	...	...	446 „
	Taheiho or Blagoveschensk	...	...	...	915 „
	Harbarovsk	...	...	...	597 „



Cambridge :

PRINTED BY JOHN CLAY, M.A.

AT THE UNIVERSITY PRESS.